The FOUNDRY

Volume 58
Number 10

Published
Semimonthly

CLEVELAND, OHIO, MAY 15, 1930

Castings Lead a Dog's Life in Holding Doors Open

THIS is a dog story. It is not the kind that might be written by Arthur Payson Terhune or the type illustrated in serial form by Robert L. Dickey. It is simply the story of the foundry pups, those lifelike reproductions of the various species of the canine family which have migrated

The Cast Iron Pup Holds His Head High, For He Is Indeed a Noble Animal

recently from numerous foundries to the homes of the elite and the domiciles of that great body of our citizens often referred to by our politicians as the "Dear People." Of course this represents the so called garden variety, recognized as the backbone of the nation. A few years ago, perhaps around the turn of the century, the cast iron dog was popular, but it was used as a decoration for the front lawn, and it remained the duty of the lowly cat to serve as a door stop. Time has witnessed the disappearance of the speeding greyhound as a lawn ornament. Through some power of magic the dog has become smaller, suitable now as a artistic door stop. Foundry pups, made of gray iron, bronze and even malleable iron may be found on display at any of the leading department and art stores. It has become fashionable to own one. And of course, the foundry pup is much superior to any other breed, because the casting process permits exact reproduction of every characteristic that the finest dogs possess.

Find Where Castings Can Be Sold.

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PUBLISHED BY THE PENTON PUBLISHING CO.,
Penton Building, Cleveland, O.
BRANCH OFFICES

CHICAGO.....1347 Peoples Gas Bldg.
CINCINNATI.....209 Edwards Bldg.
NEW YORK.....2203-2206 No. 220 Broadway
PITTSBURGH.....507-508 Oliver Bldg.
SAN FRANCISCO.....24 California Street
WASHINGTON, D. C.....1653 Pennsylvania Avenue
LONDON, ENGLAND.....416-417 Caxton House, Westminster, S. W. 1
BIRMINGHAM, ENGLAND.....14 New Street
PARIS, FRANCE.....No. 9 Rue de Londres
BERLIN, GERMANY.....Dahlmerstrasse 64A, Berlin Lichterfeld-West

Cable address, IROTRAPEN, London

SUBSCRIPTION

United States and Mexico.....$3.00 a year
Canada.....$4.00 a year
Great Britain and other Foreign Countries.....£1:0:0 a year
Single copies.....25 cents

Copies published three months or more previous to date of current issue, 50 cents each.

Member, Audit Bureau of Circulations, Associated Business Papers Inc., National Publishers' Association

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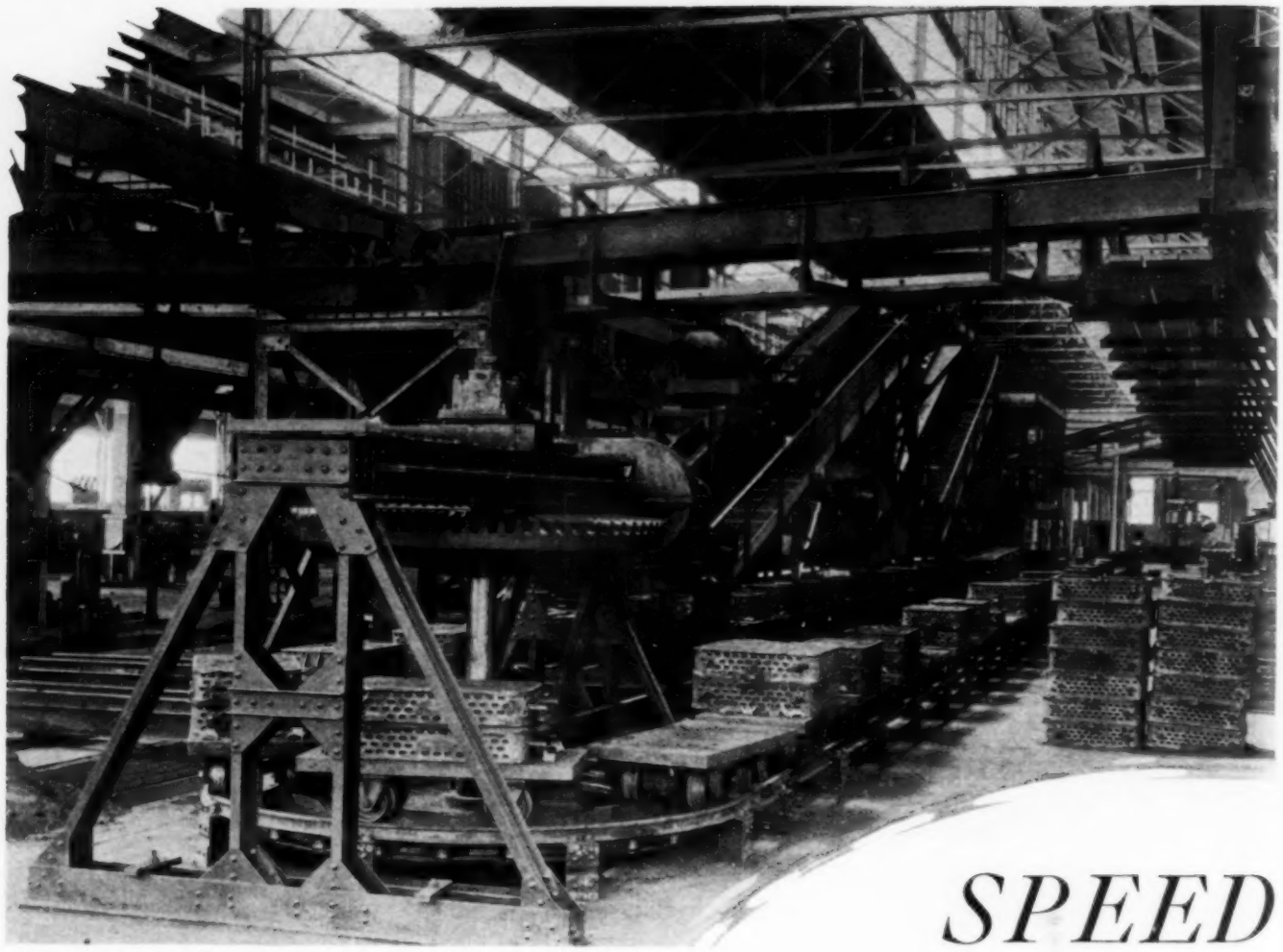


Fig. 1—Sand Preparation and Drive for Unit No. 5

SPEED in Caterpillar

PERHAPS the most important single factor in the great advances of recent years in the modernizing of the foundry industry, has been the pressure from the automobile industry for the mass production of castings. To meet this requirement, ancient traditions have been swept aside and new ideas have come to dominate the whole foundry field. The modern foundry is efficient, well ventilated, daylighted, and clean. The direct aim of modern manufacturing methods is more production at lower cost. Straight-line methods which are used to accomplish this end are merely a simplified routing of materials through the shop, with the elimination of all unnecessary handling, and the reduction to a minimum of all production operations. The new gray iron foundry just completed by the Caterpillar Tractor Co., Peoria, Ill., is an example of the trend of modern foundry design to meet the requirements of mass production in a specialized field. This company's extensive manufacturing plant at Peoria is designed for the straight-line production of large and small track type tractors, and giant harvesters on a scale no less efficient than that of the most modern and up-to-date automobile plant. Accordingly, when the company decided to produce their own castings, they were desirous of building a foundry of the latest design, one that would be in keeping with the other departments of their enormous plants. This, then

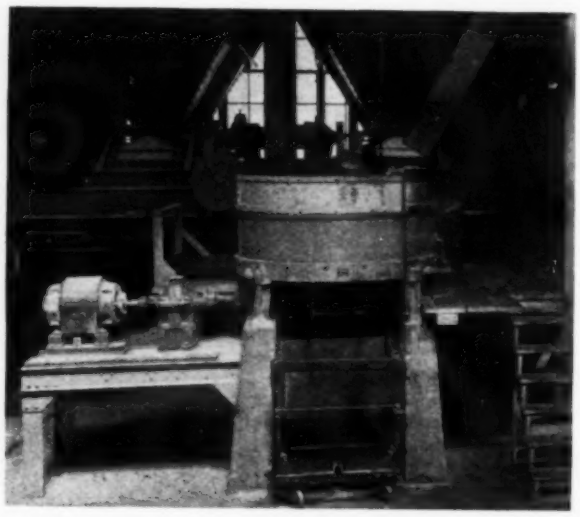


Fig. 2—Equipment for Preparing the Facing Sand Used in The Foundry

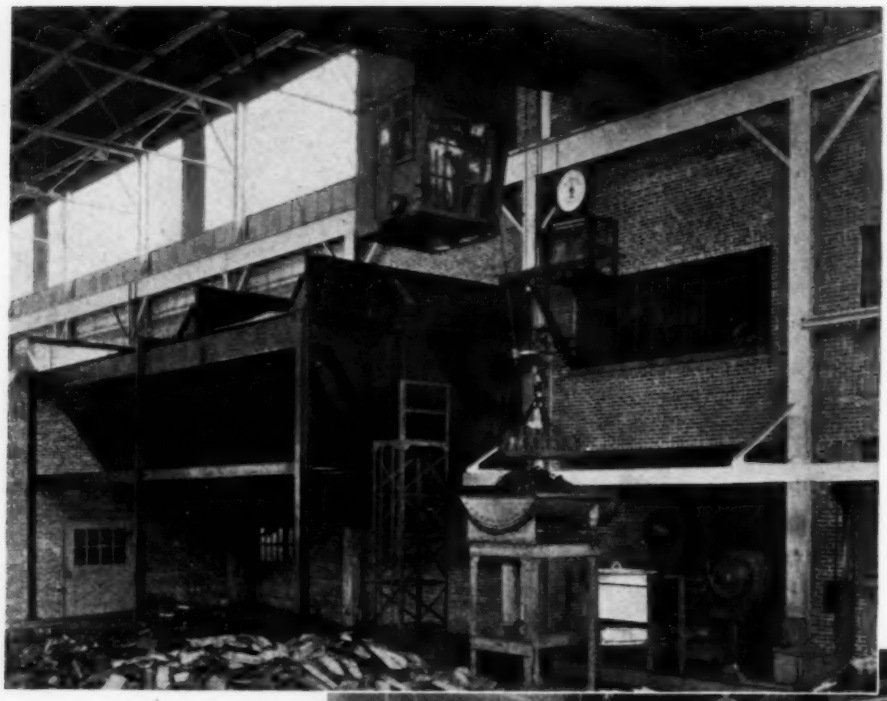
Fig. 3—The Shakeout End of the Unit Shown in Fig. 1

WORK

New Tractor Shop

was the problem confronting the Austin Co. and M. J. Gregory, manager of the foundry division of the Caterpillar Tractor Co. when they started the layout and construction of the new plant. Actual construction was started on May 20, 1929 and the first iron was poured on Jan. 14, 1930. The present capacity of the foundry is 250 tons of castings a day. Future expansion will be made at the east end of the plant. Large unobstructed floor areas, not only meet the present exacting conditions, but permit the flexibility demanded of the modern foundry which must take advantage of continually changing methods of operation. In erecting the building, it was necessary for the engineers to overcome the obstacle of constructing a heavy structure on 6 to 10 feet of hydraulic pumped fill. After tests it was found that a soil-bearing pressure of only 2000 pounds per square foot was allowable in the designing of the heavy foundations of the building, as contrasted with the average soil-bearing pressure of 6000 pounds per square foot. The building itself, 380 x 500 feet, is of steel frame construction, with brick sidewalls; the roof structure is of the modern inverted monitor type. The entire foundry is of fireproof construction. The roof covering is a four-ply built up waterproofing over cement tile. Daylight and abundant ventilation is obtained from the generous use of steel sash in

Fig. 4—The Core Sand Mixer Adjoins the Facing Sand Mixer



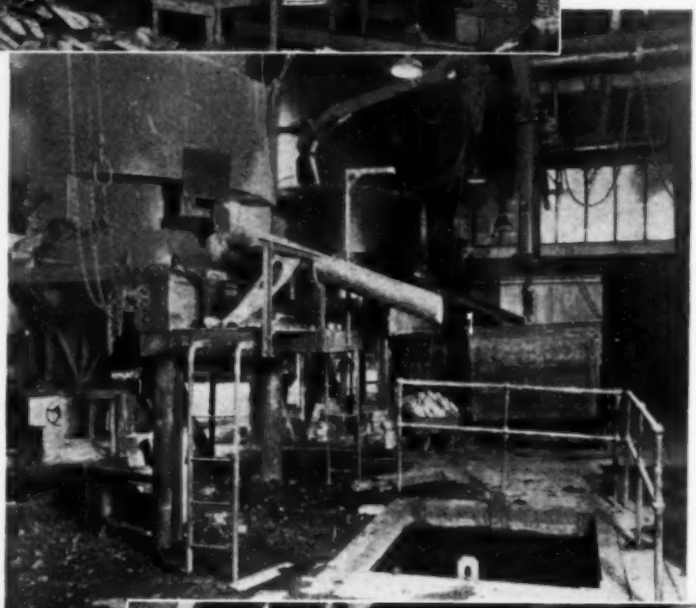


Fig. 5 — (Above) — A Yard Crane Makes up the Charges. Fig. 6—(Right) Slag from Each Cupola Flows Into a Steel Box Submerged in a Tank of Water

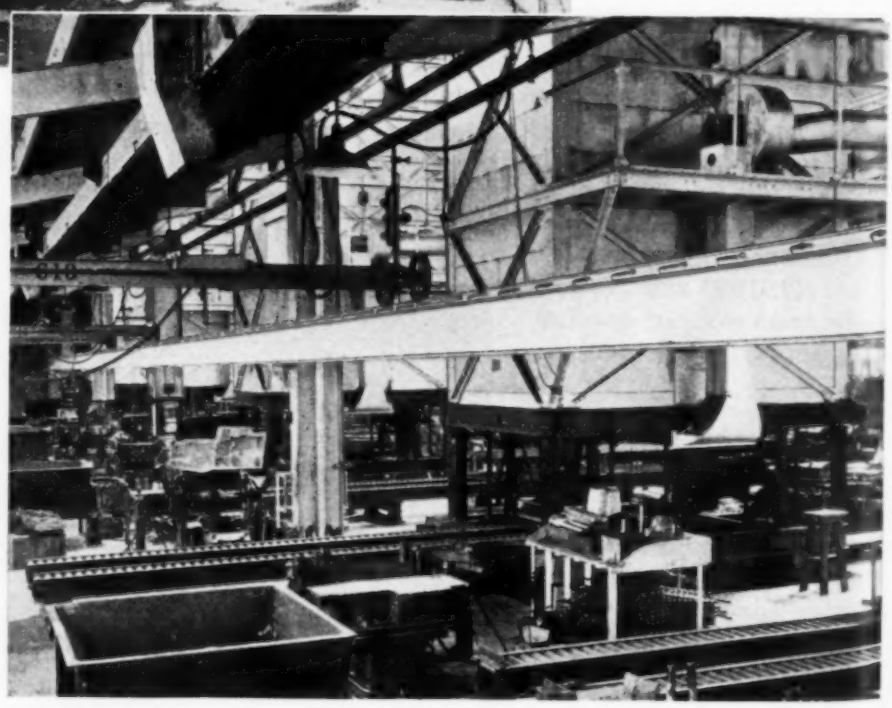
the monitors and the sidewalls. All steel sash is glazed with ⅛-inch hammered glass. The entire floor area is covered with a concrete slab. The core room has a monolithic concrete floor, while in all other departments the concrete slab serves only as a base. The foundry proper has a brick surface, the brick being laid flat and grouted in place. In the cleaning room, the concrete base is covered with 3-inch wood blocks. It is claimed that this type of floor will stand considerable abuse, and yet is easy on the workmen's feet.

The storage yard, 70 x 500 feet, is covered for 300 feet. A 10-ton yard crane, built by the Harnischfeger Corp., Milwaukee, serves 400 feet of the yard. It is used both for unloading incoming materials and making up cupola charges. When handling sand, coke, or limestone, a 1¼-yard single line bucket is attached to the crane hook, and when metal is to be handled, a 55-inch magnet is used.

When making up the cupola charges with the yard crane, the metal is picked up with the magnet and dropped into a bucket loader mounted on a platform scale which has an elevated dial so arranged that the crane operator can see just how much of each kind of metal he is putting into the charge. With a rheostat in the magnet circuit, the crane operator is able to pick up a full load of metal and drop it into the loader a few pieces at a time, at the same time watching the scale dial as he drops the load.

The complete charge in the bucket loader, is dumped into a charging bucket, on a transfer car, and taken by a roller conveyor to the charging floor, where it is picked up from above by the charging crane, hoisted to the charging floor, and delivered to the cupola. The cupolas, charging crane, buckets, bucket loader, and transfer car are all products of the Whiting Corp., Harvey, Ill. The scales used for weighing the charges were made by the Fairbanks-Morse Co., Chicago. Iron is melted in two cupolas 72 inches in diameter inside the lining, and one cupola, 54 inches. Blast for the cupolas is furnished by two centrifugal air compressors made by the General Electric Co., with volume controllers. Each compressor is rated at 10,500 cubic feet of air per minute, running at a speed of 3500 revolutions per minute. These blowers are located on the mezzanine floor back of the cupolas just below the

Fig. 7 — (Below) — Core Machines and Roller Conveyors in Vicinity of Battery of Vertical Ovens

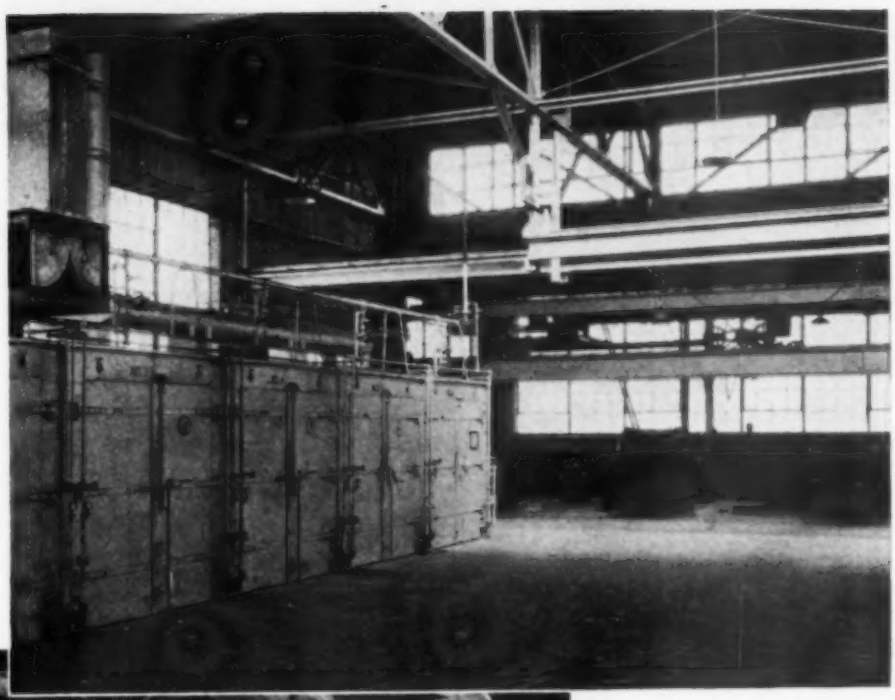


charging floor. Tests have shown exceptional rigidity in the blower floor construction. With the blowers both running, vibration is almost imperceptible. The motor generator set for supplying direct current for the hot iron monorail and small cranes, also is located on the blower floor.

Metal is carried from the cupolas to the molding floors by a 2-ton electric carrier on a monorail fabricated and installed by the Richards-Wilcox Co., Aurora, Ill.

Slag from the cupolas flows into a large steel bucket with perforated sides and bottom, submerged in a pit filled with water, at the rear of the cupolas. The molten slag dropping into the water is granulated, and is converted into good road material, a useful by-product instead of a liability in the form of material to be hauled to the dump. The filled bucket is lifted out of the pit, with an air hoist suspended from a monorail, and put in a truck to be taken out of the foundry.

Core oil is stored in a 11,000-gallon steel tank, located outside the foundry building and is pumped as required into the sand mixing room. The core sand mixing units shown in Figs. 2 and 4 are so arranged that one man can mix sand for the entire core room. The yard crane transfers sand from the storage bins to a battery of four sand hoppers under each of which is an apron conveyor, equipped with a special measuring device. The desired quantity of sand for any mix can be obtained by simply moving a pointer to the proper figure on the dial, and pushing a button to start the apron conveyors. The apron feeders deliver the sand to a belt conveyor, which carries it to an elevator, to be delivered to the sand mixers. Sand mixers made by the National Engineering Co., Chicago, and the Standard Sand & Machine Co., Cleveland, are used. The mixed core sand is delivered to the core makers by lift trucks and by an overhead crane. Cores are made on machines supplied by the Milwaukee Foundry Equipment Co., Milwaukee.



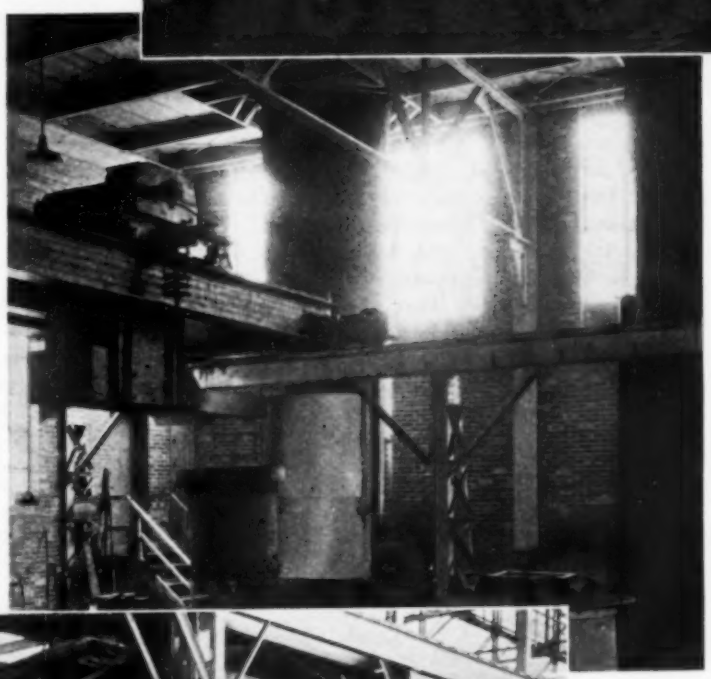
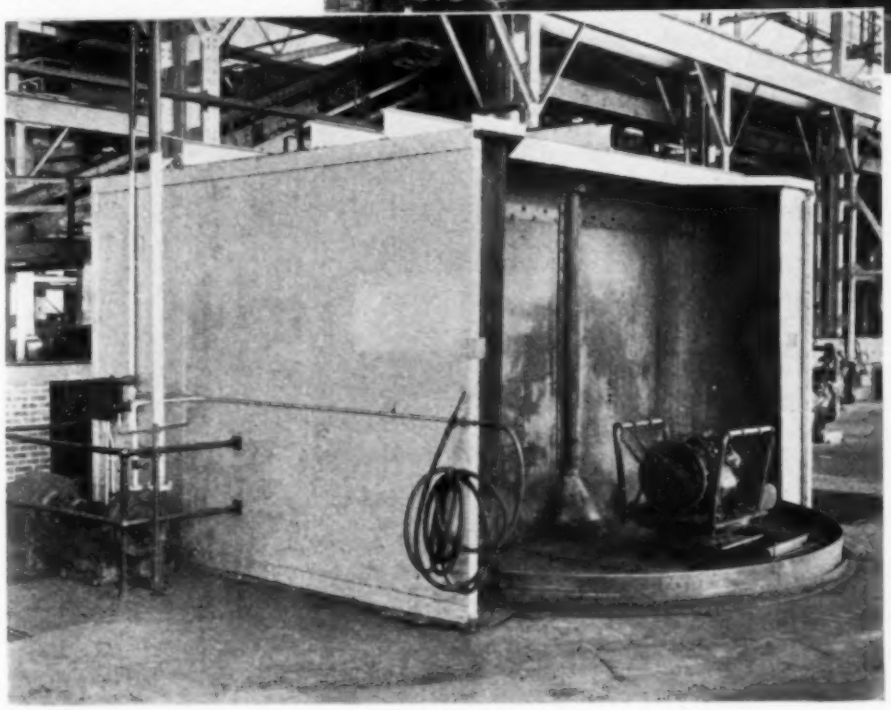


Fig. 10 — (Above) — The Smaller Cores Are Loaded on Racks and Dried in This Battery of Stationary Ovens

Fig. 8—(Below)—Interior of Hydraulic Cleaning Chamber. Fig. 9—(Right) —A Crane Places Each Charge in the Cupola.



Cores are baked in two types of ovens; vertical, oil fired, continuous and a battery of rack type, gas fired, metal ovens. Cores are carried to and from seven vertical ovens on roller conveyors. The racks are discharged automatically from the ovens upon gravity roller conveyors. Hot cores are stored for a time to cool, after which they are ground on a core grinder. The cores are fitted and taken to the molding floors on electric lift trucks. Core ovens were

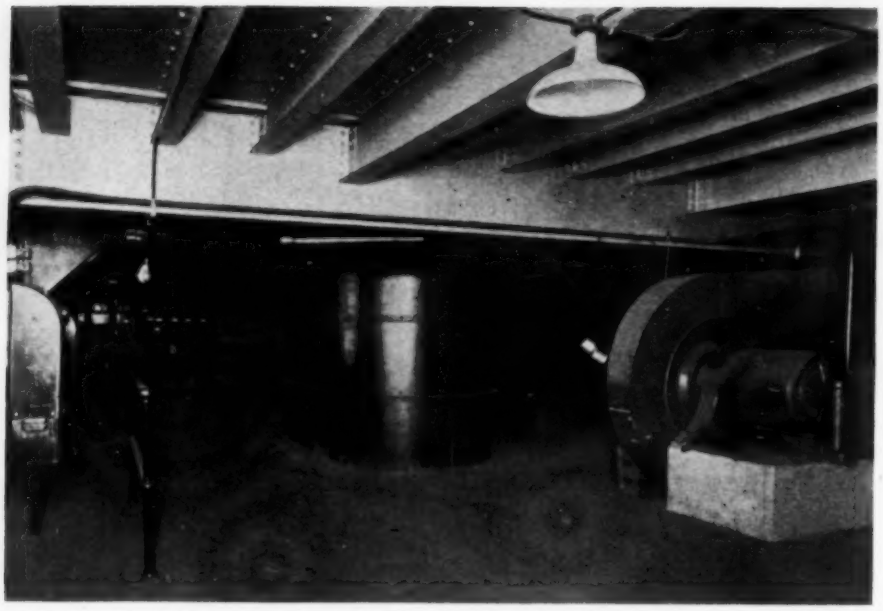


Fig. 11—Centrifugal Blowers for the Cupolas Are Mounted on the Mezzanine Floor Just Below the Charging Floor

supplied by the Foundry Equipment Co., Cleveland, and the Detroit Sheet Metal Works, Detroit.

Medium weight castings are made on two molding units, each having its own sand preparation system. In the U-shaped unit the molding machines and sand preparation systems are located within the loop. The shakeout is at the open end of the U. Starting at the shakeout, the empty flasks are taken to the molding stations on a gravity roller conveyor. The core setting zone is at the closed end of the unit and after the molds are closed they are pushed through the pouring and cooling zones to the shakeout with the aid of an air pusher.

Sand from the shakeout is carried up an incline conveyor, and passed over a vibrating screen which takes out the lumps. A short magnetic separator conveyor, furnished by the Dings Magnetic Separator Co., Milwaukee, and located just above the incline conveyor takes out any metallic scrap that may be in the sand. The sand is tempered on the incline conveyor by a series of sprays and rakes, located just above the magnetic separator conveyor.

After passing through the screen, the sand falls directly into a revivifier, consisting of two revolving cutters driven in opposite directions, which give the sand a thorough cutting. An elevator then lifts it to an overhead distributing conveyor belt from which it is plowed into sand hoppers, equipped with 4-inch pitch apron feeders.

The foregoing treatment of sand applies to backing sand only. The facing is made in another unit. The roller conveyor, and the entire sand conditioning system was built by the Dodge Mfg. Corp., Mishawaka, Ind.

The second medium molding unit is equipped with a power conveyor, and a double sand system providing backing sand for the particular unit, and facing sand for all the molding units.

Describes Conditioning System

Sand from the shakeout passes through a bar grating to a belt conveyor which discharges directly into the boot of an elevator, thence to a revivifier, mounted above a reversible distributing belt conveyor. This conveyor will carry the facing sand to a storage hopper, or when reversed will carry backing sand to the hopper, above the molding machine.

Light castings are made on two different types of continuous conveyors. The car type is shown in Figs. 1 and 3. Fig. 3 shows shakeout end, and Fig. 1 shows sand preparation and drive end. Other conveyors used include the roller and sliding plate types. Each type of conveyor has its own sand preparation unit. A double loop of the car type in units 5 and 6 is

Fig. 12—Molds Are Made and Cored on One Leg, Are Poured at the Turn and Are Shaken Out at the End of this U-roller Conveyor

about 160 feet long, center to center of sprockets, has 14 molding machines on each loop (seven copes and seven drags) spaced 10 feet on 5-foot centers. The cars on these conveyors, 18 x 24 inches, are spaced on 5-foot centers, fitted with 6-inch single flanged bronze bushed rollers, and are drawn by a 12-inch pitch chain, running on a 92-inch pitch diameter head and foot sprockets. Each of these mold conveyors is driven by a 5-horsepower motor through a four-to-one variable speed reducer, and a pair of beveled gears. The drive is at the shakeout end of the conveyor.

Has Similar Sand System

The sand preparation system for units 5 and 6 is similar to that used on the U-conveyor. The molds are shaken out on rails and the sand falls through a bar grating into a shakeout hopper, common to both mold conveyors. It is carried from the shakeout hopper to a screen on an incline conveyor using a special heat resisting belt. After passing under a magnetic separator the sand is tempered and a series of rakes help to mix and cool the sand. It passes through the screen into a revivifier, then up an inclined rubber belt conveyor to a 60-ton storage bin. This bin is divided into three parts, each part equipped with an apron feeder, which can be operated independently. By taking sand from these bins in rotation, cool, well tempered sand is always available.

Sand from these bins is elevated by cross conveyors, from which two distributing belt conveyors take it to the individual hoppers above the molding machines. Excess sand from the distributing conveyors is returned to the shakeout on a cross conveyor, making a closed cycle.

Metal is brought to these conveyors on a monorail, and transferred to pouring ladles from which it is poured

(*Concluded on Page 90*)

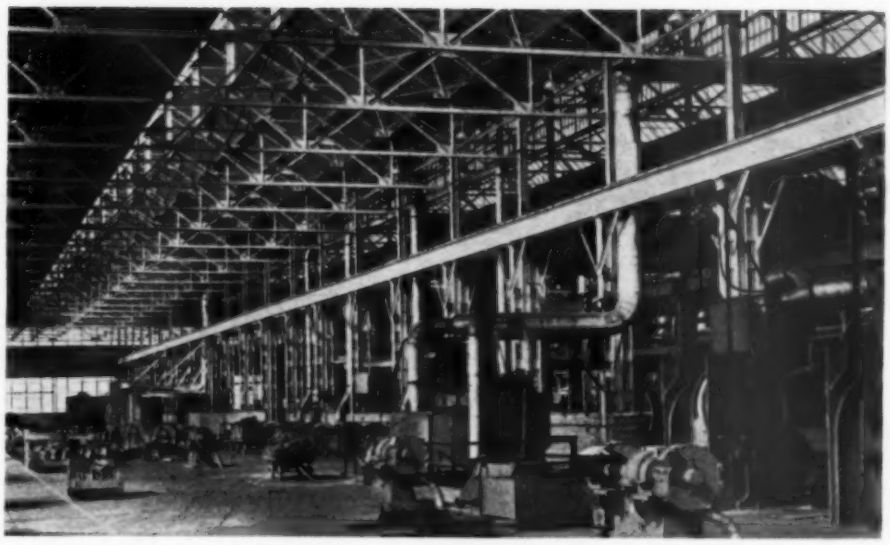


Fig. 14—General View of the Cleaning Department of the Foundry

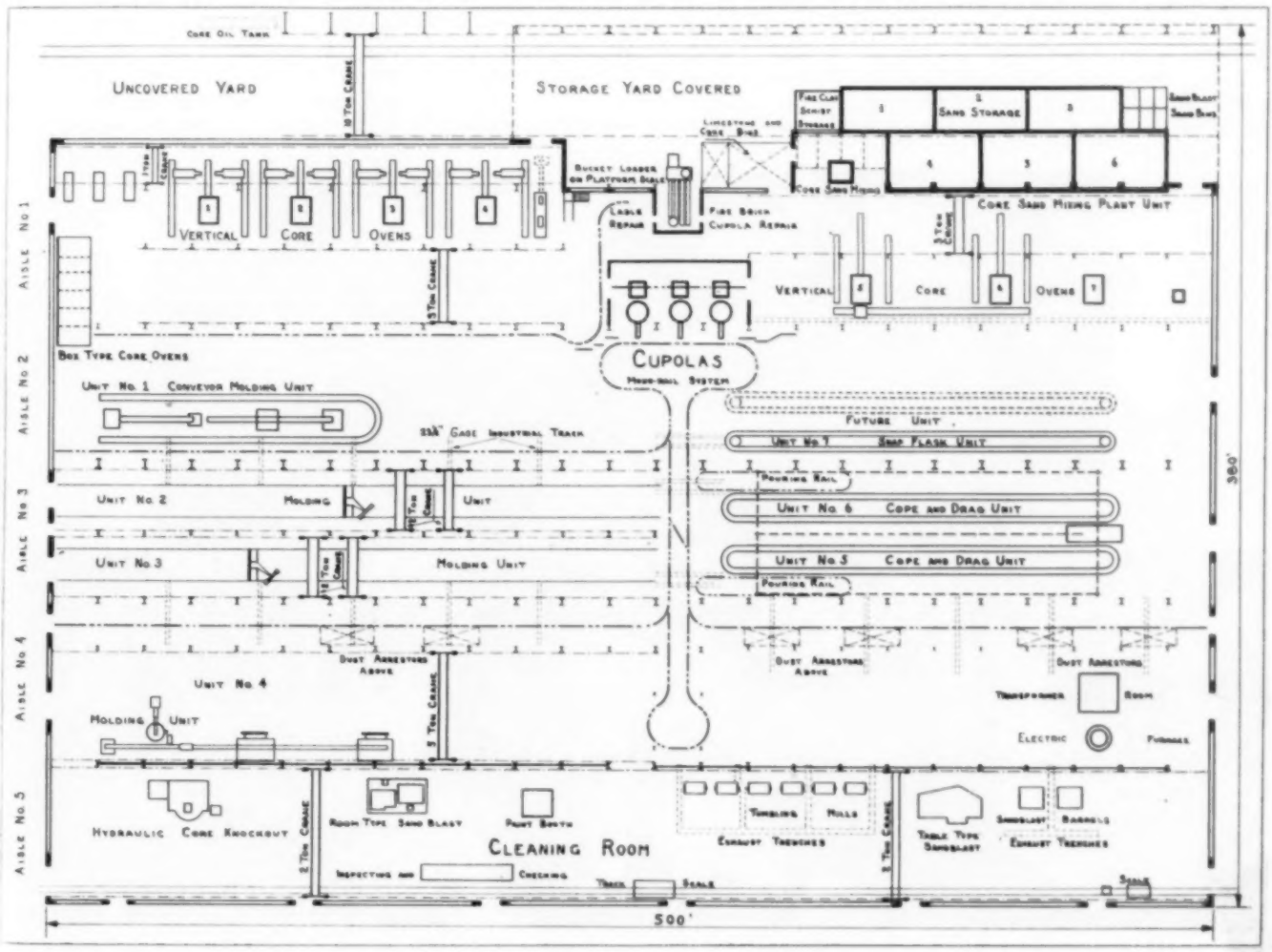


Fig. 13—General Layout of the Foundry Showing the Relative Position of the Various Departments

SAND CONTROL
Increases Economy in the Foundry

Shows the Effect of Mixing Fine and Coarse Grades of Sand—Describes Electric Moisture Determiner

By O. E. J. Abrahamson

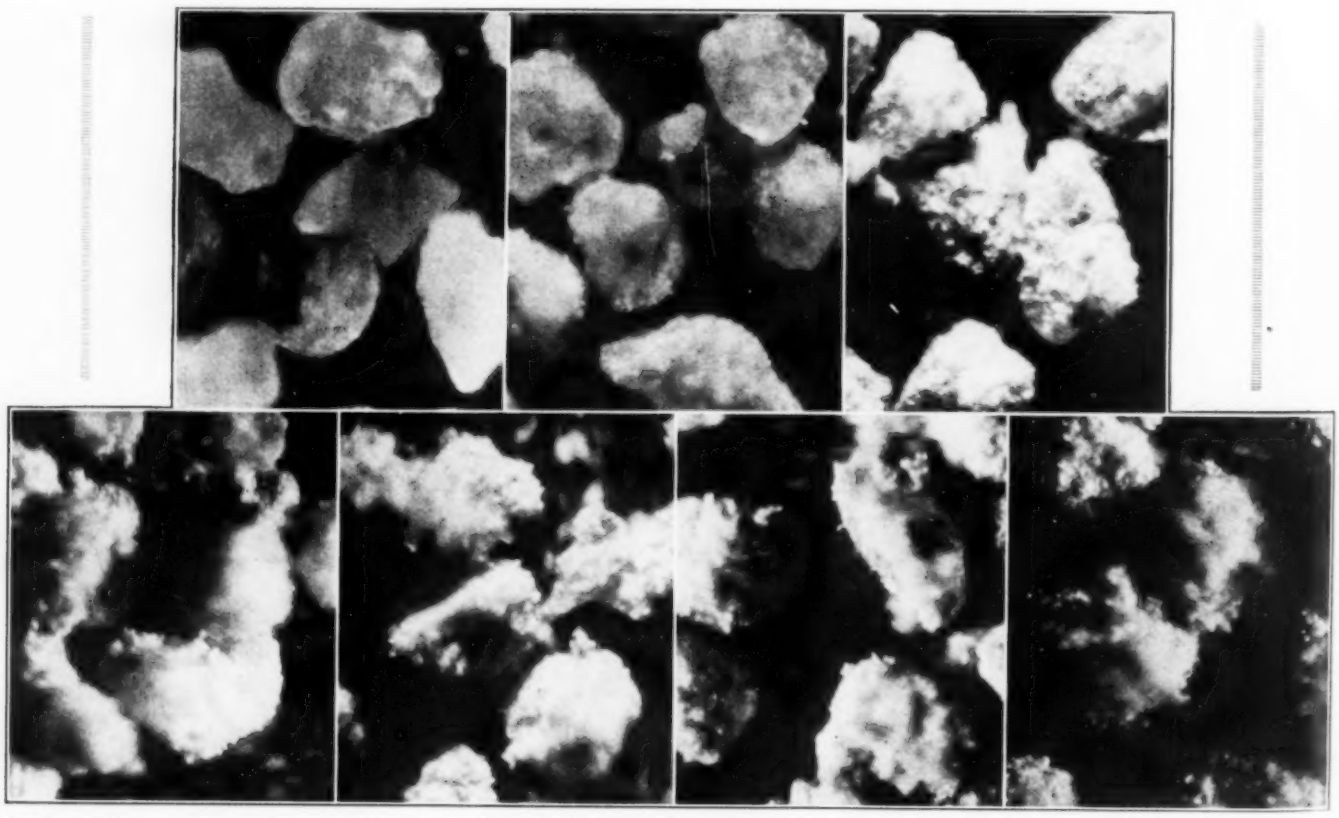
RELATIONSHIP between average permeability, average grain size and bond or *clay* is shown in Figs. 3, and 4 contained in the first article of this series. The average permeability, that is, the permeability at 3, 5, 7 and 9 per cent moisture, has been used in making these charts since it was found that, depending on the percentage of bond, fine grains, coarse grains, etc., the optimum percentage of moisture would be from 1 per cent up to as high as 15 or 16 per cent. However, for the average run of molding sands containing up to 20 per cent colloidal bond the optimum water content would be from 1 to 12 per cent.

From this it is apparent that to strike an average permeability that could be employed in comparing all types of sand, it would be necessary to incorporate a full range of moistures. However, after considerable experimenting it was found that highly satisfactory results were obtained by using 3, 5, 7 and 9 per cent moisture.

These charts are based on grain sizes uniform within certain limits and will not hold true when mixing such extreme limits as grains retained on a 65 mesh sieve having an average diameter of 0.0123-inch and extremely fine subpan grains having a diameter of 0.0005-inch. The reduction in the permeability of the coarser grains by the gradual addition of the finer ones is shown on Table X and Fig. 22. This table and chart show that by the time 40 per cent of the fine grains have

Tabulates Data

ADDITION of fine grades of sand to those of a coarser grade rapidly reduces the permeability of the mixture. In one instance the addition of 40 per cent fine sand reduced the permeability 99 per cent and the addition of 50 per cent gave a permeability less than the fine sand alone. This article which is the third of a series also includes a list of the information that may be obtained from tests and describes the electrical determination of moisture content.



FIGS. 15 TO 21—(TOP, LEFT TO RIGHT)—UNBONDED SAND GRAINS THROUGH 65 AND ON 100 MESH SIEVE; SAME WITH 5 PER CENT BOND, AND WITH 10 PER CENT BOND. BOTTOM LEFT TO RIGHT—SAME SAND WITH 15, 20, 25 AND 30 PER CENT BOND

been added the permeability has been reduced by 99 per cent and when a mixture of 50-50 is reached the permeability for the mixture is less than the permeability of the fine material itself due to the reduced porosity of the mixture.

This is interesting from a practical point of view, since it makes clear that even substantial additions of a coarse grained sand to a sand mixture does not open it up or increase the permeability, especially when dealing with sands free from or low in bond where it is necessary to add 60 to 70 per cent of the coarse material before any marked increase in permeability occurs. Foundrymen, from the molder up to the manager, often say when they believe that their sand heaps are too tight, that is lacking in permeability, "Add a little core sand and open it up."

When the percentage of one wheel barrow of core sand added to a 5 to 50-ton sand heap is calculated, the futility of such attempts is readily realized. However, what does happen when such practices are resorted to, is the bringing about of an increase in the density of the sand, which in turn under certain conditions results in a more satisfactory molding sand that helps the molders to get rid of some of their troubles.

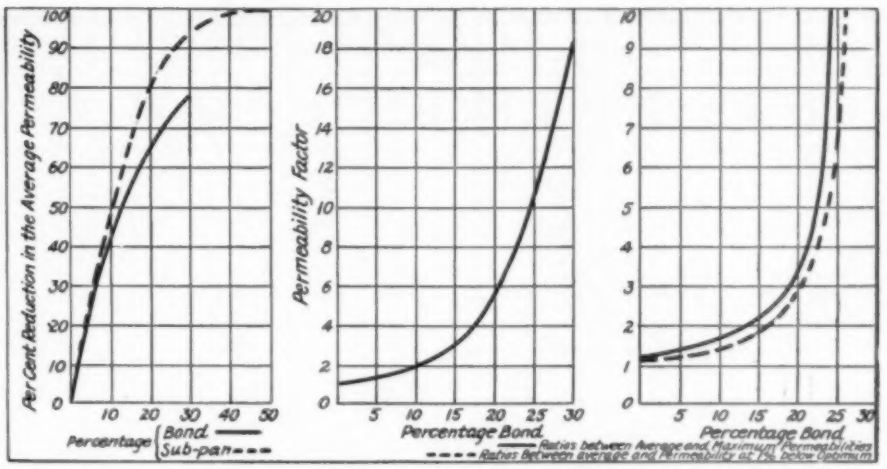


FIG. 22—REDUCTION IN AVERAGE PERMEABILITY BY BOND AND SUBPAN MATERIAL. FIG. 23—PERMEABILITY FACTOR DERIVED FROM FIG. 22. FIG. 24—MULTIPLICATION FACTOR FOR DETERMINING PERMEABILITY AT OPTIMUM MOISTURE OR ONE PER CENT BELOW THAT VALUE

From Fig. 22 the permeability factor, as shown on Fig. 23, was calculated. The use of this factor in determining the average grain size of a sand exclusive of bond and fine pan material and in mixing sand by analysis will be dealt with later on and in a succeeding article.

In most natural and blended sands and even in sands manufactured from bonding clays, with the exception of highly colloidal clays such as bentonite, and waste sands of one kind or another, a percentage of fine pan material or fine inert particles is present in practically the same proportions as the percentage of bond and therefore the permeability factors have been quoted for each percentage of bond. Where fine, uniformly

Table IX

Number of Grains Per Gram of Molding Sand

Grain Size Inch	PERCENTAGE BOND 0	4	8	12	16	20	24	28	32	36
.0100.....	44850	43056	41262	39468	37674	35880	34086	32292	30498	28704
.0090.....	61198	58750	56302	53854	51406	48958	46510	44062	41614	39166
.0080.....	87851	84477	81103	77729	74355	70981	67607	64233	60859	57485
.0075.....	106306	102054	97802	93550	89298	85046	80794	76542	72290	68038
.0070.....	130306	125094	119882	114670	109458	104246	99034	93822	88610	83398
.0065.....	163606	157062	150518	143974	137430	130886	124342	117798	111254	104710
.0060.....	208045	199723	191401	183079	174757	166435	158113	149791	141469	133147
.0055.....	270738	259908	249078	238248	227418	216588	205758	194928	184098	173268
.0052.....	319550	306768	293986	281204	268422	255640	242858	230076	217294	204512
.0049.....	382690	367382	352074	336766	321458	306150	290842	275534	260226	244918
.0047.....	432844	415530	398216	380902	363588	346274	328960	311646	294332	277018
.0045.....	493446	473708	453970	434232	414498	394756	375018	355280	335542	315804
.0043.....	565957	543319	520681	498043	475405	452767	430129	407491	384853	362215
.0041.....	649591	623607	597623	571639	545655	519671	493687	467703	441719	415735
.0039.....	757400	727104	696808	666512	636216	605920	575624	545328	515032	484736
.0036.....	962500	924000	885500	847000	808500	770000	731500	693000	654500	616000
.0035.....	1047106	1005222	963338	921451	879570	837686	795802	753918	712039	670150
.0034.....	1143444	1097706	1051968	1006230	960492	914754	869016	823278	777540	731802
.0033.....	1253312	1203180	1153048	1102916	1052784	1002652	952520	902388	852256	802124
.0032.....	1372694	1317786	1262878	1207970	1153062	1098154	1043246	988338	933430	878522
.0031.....	1507790	1447472	1387160	1326848	1266536	1206224	1145912	1085600	1025288	964976
.0030.....	1661122	1594678	1528234	1461790	1395346	1328902	1262458	1196014	1129570	1063116
.0029.....	1843350	1769616	1695882	1622148	1548414	1474680	1400946	1327212	1253478	1179744
.0028.....	2044756	1962966	1881176	1799386	1717596	1635806	1554016	1472226	1390436	1308646
.0027.....	2276638	2185572	2094506	2003440	1912374	1821308	1730242	1639176	1548110	1457044
.0026.....	2544756	2442966	2341176	2239386	2137596	2035806	1934016	1832226	1730436	1628646
.0025.....	2870400	2755584	2640768	2525952	2411136	2296320	2181504	2066888	1951872	1837056
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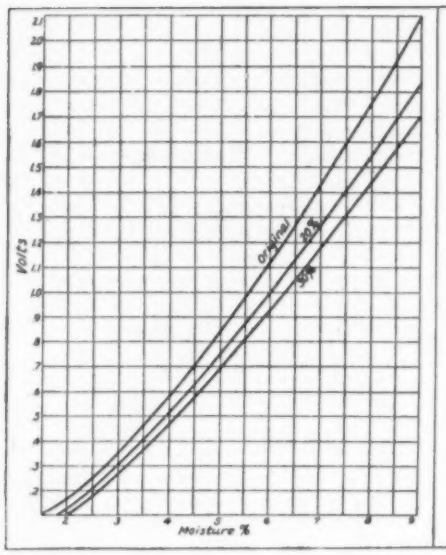
.0023.....	3670906	3524070	3377234	3230398	3083562	2936726	2789890	2643054	2496218	2349385
.0022.....	4230210	4061002	3891794	3722586	3553378	3384170	3214952	3045744	2876536	2707328
.0021.....	4853550	4659408	4465266	4271124	4076982	3882840	3688698	3494556	3300414	3106272
.0020.....	5606250	5382000	5157750	4933500	4709250	4485000	4260750	4036500	3812250	3588000
.0019.....	6522294	6261402	6000510	5739618	5478726	5217834	4956942	4696050	4435158	4174266
.0018.....	7700000	7392000	7084000	6776000	6468000	6160000	5852000	5544000	5236000	4928000
.0017.....	9116200	8751552	8368904	8022256	7657608	7292960	6928312	6563664	6199016	5834368
.0016.....	10901300	10465248	10029196	9593144	9157092	8721040	8284988	7848936	7412884	6976832
.0015.....	13289000	12757440	12225880	11694320	11162760	10631200	10099640	9568080	9036520	8504960
.0014.....	16358048	15703728	15049408	14395088	13740768	13086448	12432128	11777808	11123488	10469168
.0013.....	20358048	19543728	18729408	17915088	17100768	16286448	15472128	14657808	13843488	13029168
.0012.....	25902848	24866736	23830624	22794512	21758400	20722288	19686176	18650064	17613952	16577840
.0011.....	33841680	32488016	31134352	29780688	28427024	27073360	25719696	24366032	23012368	21658704
.0010.....	44850000	43056000	41262000	39468000	37674000	35880000	34086000	32292000	30498000	28704000
.0009.....	61600000	59136000	56672000	54208000	51744000	49280000	46816000	44352000	41888000	39424000
.0008.....	87210400	83721984	80233568	76745152	72256736	69768320	66279904	62791488	59303072	55814656
.0007.....	130864384	125629824	120395264	115160704	109926144	104691584	99457024	94222464	88987904	83753344
.0006.....	207222784	198933888	190644992	182356096	174067200	165778304	157489408	149200512	140911616	132622720
.0005.....	358800000	344448000	330096000	315744000	301393000	287040000	272688000	258336000	243984000	229632000



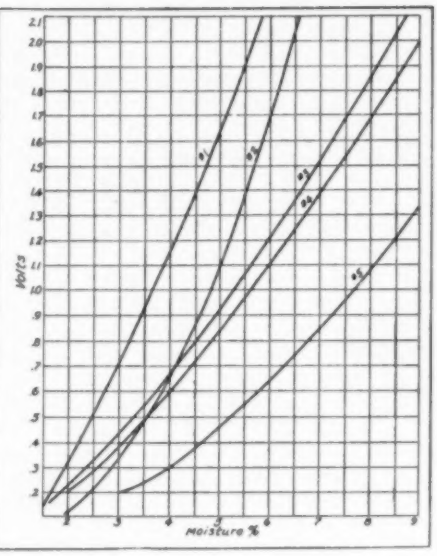


FIG. 25—CURVES SHOWING EFFECT OF NEW SAND ADDITIONS. FIG. 26—MOISTURE CURVES FOR FIVE DIFFERENT SANDS

grained and heavily bonded molding sands are being studied it must be borne in mind that this factor does not work to perfection, since as previously stated a critical point is reached at about 40 per cent fine. However, by mixing such a sand with sharp sand of known average permeability (25 to 50 per cent fine sand and 75 to 50 per cent sharp sand) and analyzing this mixture as outlined, the amount of bond as well as the amout of fine pan material present may be determined readily by a few simple calculations.

Permeability Varies

The maximum permeability of a sand is higher than the average permeability in almost direct proportion to the percentage of bond present. However, most molding sands, especially for light casting purposes, are not worked at their optimum permeability water content but most frequently at one per cent below this point. Consequently a set of curves were drawn as depicted in Fig. 24, to show the factor by which to multiply the average permeability to obtain the permeability at the optimum water content or one per cent below this point. Table XI shows the various factors tabulated from Figs. 23 and 24.

In the analysis of a molding sand according to the procedure outlined in this and preceding articles the following information is obtained:

Average permeability for 3, 5, 7 and 9 per cent moisture.

Average ratio at the optimum water content, plus and minus 1 per cent moisture.

Average hardness at optimum, plus and minus 1 per cent moisture. From this data, by consulting the various charts and tables, additional information, as presented in Table XII, is gained.

Bond (active).

Permeability factor.

Table X

Data on Mixtures

Per Cent Sub Plan (0.0005 inch diameter)	Per Cent 65 Mesh (0.0123 inch diameter)	Average Permeability
0.0	100.0	278
.5	99.5	260
1.0	99.0	257
2.0	98.0	246
3.0	97.0	229
10.0	90.0	149
20.0	80.0	51.9
30.0	70.0	15.5
40.0	60.0	3.12
50.0	50.0	1.78
60.0	40.0	1.41
70.0	30.0	1.40
80.0	20.0	1.44
90.0	10.0	...
100.0	0.0	2.2

Average grain diameter exclusive of bond and fine pan material of which the *bond* is readily determined by reading the average ratio on the average hardness curve in Fig. 14. The average grain diameter, exclusive of bond and fine pan material, is obtained by multiplying the average permeability by the permeability factor and the resulting permeability value followed horizontally on Figs. 3 and 4 until the vertical line representing the percentage in question is reached. Here the average grain size, as represented by the curved lines, is found either directly or by interpolation.

The number of grains per gram, exclusive of bond and fine pan material, is obtained in one of the following two ways:

The number of grains per gram of sand free from bond for any grain size expressed in fractions of an inch is obtained by consulting the first and second columns of Table IX, either directly or by interpolation. The number of grains per gram of bond free sand for the grain size in question times 2 times the percentage of bond divided by 100 is then the number of grains per gram of the sand exclusive of bond and fine pan material.

Multiply the percentage of bond by two. Follow the vertical column on Table IX having the percentage of bond nearest this product until the horizontal line opposite the nearest grain size in question is reached; then read directly or interpolate. The figure thus obtained is the number of grains per gram of sand for the grain size and percentage of bond involved less the bond and fine pan material.

To obtain the moisture in molding sands rapidly and as simply as possible and at the same time accurately enough for control purposes, the method which will be described has proved quite satisfactory. The moisture is determined at the same time and in connection with the permeability test and part of the equipment used in the permeability test also is used in the moisture test.

Plot Separate Curves

The difference in the nature of the molding sands used in the foundries today and also the difference in carbon content in these sands presents the first difficulty from the electrical point of view in that they vary con-

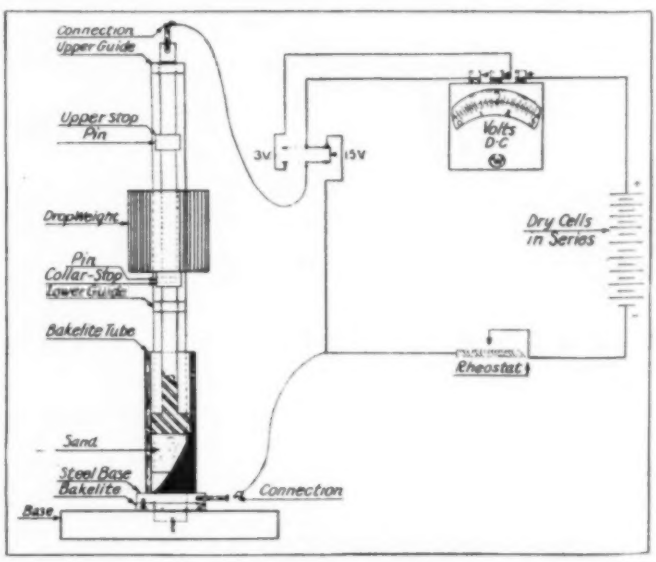


FIG. 27—DETAILS OF THE ELECTRICAL MOISTURE DETERMINING APPARATUS

siderably in conductivity. This, however, is overcome quite readily by plotting separate curves for each foundry or each heap or both.

A few small changes have to be made on the equipment used for the permeability test as follows:

The brass tube previously mentioned is replaced by a bakelite tube, or one made from a similar nonconducting material, with the same diameter (2 inches) and approximately ¼-inch in wall thickness. The base on which this tube is placed for ramming is reduced in thickness about ¼-inch and a piece of fiber or bakelite ¼-inch thick is screwed onto the bottom, with the heads of the screws countersunk and covered with shellac. The base also is drilled and tapped for a small brass screw to serve as one connection through the sand. The other connection through the sand is obtained by drilling and tapping the top of the rammer rod for another brass screw.

Procedure Is Fixed

The electrical equipment consists of one double scale, direct current voltmeter reading 15 volts on the top scale and 3 volts on the lower scale. The divisions on the top scale are equal to ½-volt and the divisions on the bottom scale are equal to 1/10-volt. A rheostat of the radio type having from 0 to 200 or 0 to 500 ohms resistance and seven to ten 1½-volt dry cells are all that are required except the occasional replacement of a dry cell.

After the installation has been made according to the accompanying diagram about 6 to 8 pounds of a representative sample of heap sand is dried thoroughly and a small 200-gram sample is prepared using 10 per cent moisture or high enough water content to make the sand too wet for molding purposes. A sufficient amount of this sand is rammed up in the bakelite tube to give a 2-inch specimen with three rams of the standard permeability rammer. With this done and the spring clips attached to top and bottom as indicated in Fig. 27, the switch is thrown to the side reading three volts and note is made of the position of the pointer on the voltmeter. Dry cells are added or removed to obtain a voltage that will cause the pointer to read between two and one half and slightly less than three volts with no resistance being used in the rheostat. The switch next is thrown to the 15-volt side and if, for example, the meter then reads 12¾ volts, resistance is introduced until the meter reads exactly 12 volts. The switch is again thrown to the 3-volt side and the reading in volts then obtained is taken for the moisture known to have been added to the sand mixture.

If 12 volts are used as a constant, it is essential to have a potential from 12½ to 13 volts to compensate for the natural weakening of the dry cells. This excess voltage, however, should not be more than 1½ volts and as this excess voltage is eventually used up it becomes necessary to replace one or two dry cells with new ones so as to maintain a slight excess over the voltage at which the curve was plotted.

Daily Tests Made

The voltage now is maintained constant by the use of the rheostat and samples are prepared from the remaining dry sand containing 2, 3, 4, 5, 6, 7, 8 and 9 per cent moisture, rammed up as mentioned and note made in each case of the voltage reading on the 3-volt side. These readings are plotted as curves similar to those shown in Figs. 25 and 26 using percentage of moisture as the abscissa and volts as the ordinate. To check the additions of moisture made it is advisable before making the curve to dry the various samples used in the tests to obtain the absolute moisture in each case.

Samples are taken from the foundry each day and the voltage readings are taken and checked on the original against the oven drying method. Slight alterations in the curve might be necessary that it may conform to the condition of the sand as it comes directly from the foundry. After this check up has been made for a week or ten days, readings on the final curve should not vary more than 0.25 per cent from day to day from the moisture percentages as found by drying, provided that the

Table XI

Factors Tabulated from Curves

Per Cent Bond	Permeability Factor	Ratios Between Average Permeability and Permeability at Optimen Water Content	Ratios Between Average Permeability and Permeability at One Per Cent Below Optimum Water Content
0	1.00	1.15	1.06
1	1.07	1.17	1.07
2	1.12	1.20	1.09
3	1.19	1.24	1.11
4	1.27	1.27	1.13
5	1.34	1.30	1.15
6	1.42	1.35	1.18
7	1.52	1.40	1.21
8	1.62	1.45	1.25
9	1.75	1.51	1.30
10	1.87	1.58	1.34
11	2.05	1.65	1.40
12	2.25	1.75	1.46
13	2.45	1.85	1.54
14	2.70	1.96	1.63
15	2.94	2.09	1.75
16	3.29	2.24	1.88
17	3.64	2.42	2.04
18	4.12	2.63	2.22
19	4.70	2.90	2.44
20	5.35	3.25	2.70
21	6.05	3.69	3.04
22	6.89	4.35	3.45
23	7.85	5.43	4.00
24	8.90	7.75	4.82
25	10.00	....	6.00
26	11.25	....	9.40
27	12.50	....	....
28	14.15	....	....
29	16.00	....	....
30	18.20	....	....

Table XII

Essential Information on a Molding Sand

1	2	3	4	5	6	7	8	9
Average Permeability (at 3, 5, 7 and 9 per cent Moisture)	Average Permeability Ratio Between One and Three Rams at Optimum + 1 per cent Moisture	Average Hardness at Optimum and + 1 per cent Moisture	Per Cent Bond	Permeability Factor and Value Used in Arriving at Average Grain Size Exclusive of Bond and Pan Material		Average Grain Size Exclusive of Bond and Pan Material Inch	Number of Grains per Gram of Bond Free Sand i.e. Exclusive of Bond and Pan Material	Number of Grains per Gram of Sand Exclusive of Bond and Pan Material (in round numbers)
				Factor	Permeability Value			
100.5	1.22	27.9	1.5	1.1	1.1x100.5 = 110.5	0.0056	157,000	$\frac{(100-2x1.5) \times 157,000}{100} = 152,300$
9.8	2.85	13.7	16.3	3.4	3.4x9.8 = 33.3	0.0049	382,690	$\frac{(100-2x16.3) \times 382,690}{100} = 258,000$
3.9	4.17	12.4	21.1	6.2	6.2x3.9 = 24.2	0.0047	432,844	$\frac{(100-2x21.1) \times 432,844}{100} = 250,000$

For permanent record, however, only columns 1, 4, 7, and 9 need be retained. The other columns merely contain data essential to establish the values contained in the four columns mentioned above.

nature of the sand is not changed too rapidly. After this method for moisture determinations has been established, it is advisable to check an occasional sample by the oven drying method to make sure that no great physical change in the sand has taken place.

Excellent results are obtained in this way and little or no difficulties should be experienced in making moisture determinations in this manner. However, the nature of the sand should not be changed too suddenly by large additions of new sand or substantial increases in the carbon content of the sand (sea coal). The iron shot present in the sand exercises no influence on the readings. As much as 35 per cent by weight has been intermixed with the sand without any variation in the readings whatsoever.

When the permeability as well as the moisture is to be determined in a sample of sand, the permeability for one ram is determined as usual, the specimen then returned to the rammer and given two additional rams. Before raising the rammer from the sand specimen after the third ram the connections are made as outlined above, care being taken not to disturb the contact between the ram rod and the sand, and the reading on the voltmeter observed. The specimen is then removed and the permeability for three rams obtained.

Care also should be exercised to have as nearly as possible the same volume of sand in each case. The bakelite tube should be cleaned frequently to prevent the formation of a coating of carbon on its inside.

Aluminum Pan Needs Many Runners

By Joseph McGinnis

THE aluminum casting shown in Fig. 1 was one of four which when machined and assembled made a vacuum pan 8 feet 4 inches wide, 12 feet 6 inches long, and ¼-inch thick. A flange on the ends and sides was 2½ inches deep, ⅝-inch thick at bottom and ⅞-inch at top. The side flanges on the two center castings and on the inner side of the

FIG. 1—METAL WAS INTRODUCED ALL ALONG THE SIDES AND ENDS

two outer ones were ⅜-inch on bottom and ⅝-inch thick on top. Each section of the pan was divided into six compartments by five ribs 25 inches apart. These ribs were ¼-inch thick at bottom and ½-inch at top. Bottom of flanges and ribs were flush.

To make these castings apparently is a simple proposition, but to run them, keep them from cracking and have them come straight, especially the outer casting with a heavy flange on one side, is not so easy. The knowledge that a competitor had lost three in succession did not help solve the problem.

We decided to pour them six up, two pots at each side and one at each end to insure a quick and uniform distribution of the metal. Runners were cut as long as the castings on both sides for two reasons. First, to prevent the casting from pulling apart (the total contraction was about 2⅜ inches). Second, to insure as nearly as possible, a uniform cooling speed all over the casting.

The two inner castings came out of the sand practically straight. The inner sides of the two outside castings also were straight. The sand was stripped from the runners and part of the heavy flange on the outside castings, as soon as possible after they were poured.

One of these castings was broken in the machine shop and had to be replaced, the others were all right. They were made from the well known No. 12 alloy, 92 per cent aluminum, 8 per cent copper and 2 pounds of an alloy, 50 per cent silicon and 50 per cent aluminum, were added to each 100 pounds of the metal.

The pouring arrangement shown in Fig. 2, was due to the fact that only seven men were available to handle the six pots. With the metal melted and the pots skimmed, one man helped the other six to place the pots on horses, as shown. At the word "Go" the pots were poured simultaneously.

The original intention was to place the flat risers as shown in Fig. 2, but when the cope was received it was seen that this was not possible unless the cope was rebarred. Rather than do that the risers were placed as shown in Fig. 1.

The weight of each outer casting was 235 pounds and of each inner one, 210 pounds.

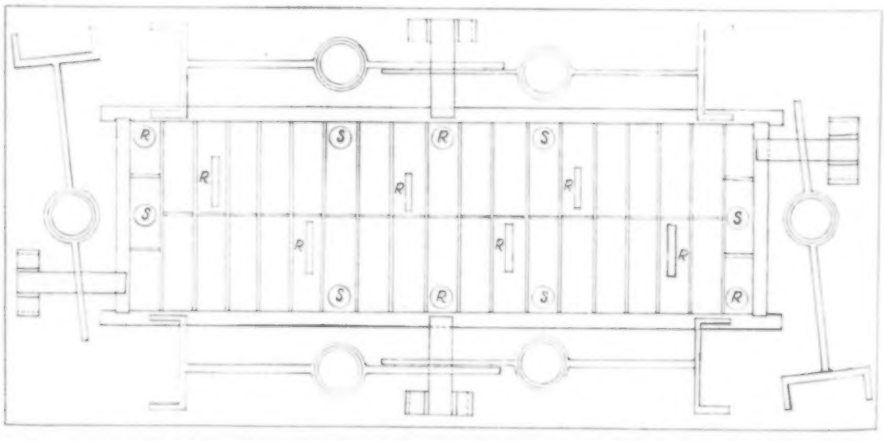


FIG. 2—THE SINGLE ENDS OF THE SIX SHANKS WERE SUPPORTED ON HORSES TO ENABLE A SMALL CREW TO HANDLE THE METAL. RUNNERS AND RISERS ARE SHOWN RESPECTIVELY BY THE LETTERS *S* AND *R*

To Occupy New Plant

The C. J. Tagliabue Mfg. Co., Brooklyn, N. Y., recently acquired the 5-story building of the American Tobacco Co., extending on Park avenue from Nostrand avenue to Sanford street in Brooklyn. In the projected removal to Park avenue the company will enlarge to more than double its present facilities at the Brush terminal plant. The new building will be occupied about the first of July.

Apply Continuous Process To Malleable Practice

By B. R. Mayne

TREND of modern industry is to produce a better product at a lower cost. In the past, malleable foundries did not give a great deal of thought to conveyor equipment, although by its use many gray iron plants were reducing their molding costs considerably. The Saginaw Malleable Iron division, General Motors Corp., Saginaw, Mich., was melting around 200 tons of iron daily in four oil-fired air furnaces. This melting equipment did not seem feasible for continuous melting, and it was deemed necessary, therefore, to look for a process that would give a continuous supply of hot iron and also would be flexible so that production could be varied up to 40 tons per hour.

Consider Processes

A steady supply of good metal is essential to the success of continuous molding operation. Various processes were considered before deciding on one that would result in a satisfactory iron at a cost comparable with that of the air furnace, or, more essential, one that would produce iron in the ladle at a lower cost per ton than the air-furnace process.

Numerous processes could be used to produce a satisfactory iron, but when all items were considered—such as supply of raw material, flexibility of operation, cost of metal at the spout, quality of iron and other factors—we decided on the cupola-electric process, or, as it is commonly referred to, the "duplex process for making malleable iron."

Before making extensive changes in the plant, a series of tests was conducted at the research laboratories of the General Motors Corp., to assure the practicability of this process, which had previously been tried out in Europe, where it failed to produce a commercial malleable iron. From the beginning, tests proved that the process had possibilities, and within a few weeks a good commercial malleable iron was being produced.

With the preliminary work completed, the next step was to lay out the process on a commercial basis to fit into the building already constructed at the plant. Part of the old foundry was used for the mold conveyors and a new building was constructed for the melting department, which housed the cupolas, electric furnaces, transformers and generators.

Gives Much Data

NEED for a continuous pouring system in a malleable iron foundry led to an investigation of melting methods and the final adoption of cupolas for melting the cold stock, and electric furnaces for refining and raising the temperature of the cupola metal. The author gives data on the use of soda ash as a desulphurizer, life of refractories, metal charges, and other information pertinent to the process. Metal at the cupola spout averages 2800 degrees while that at the electric furnace spout is 2950 degrees Fahr. The author of the article, which is abstracted from a paper presented at the Cleveland convention of the American Foundrymen's association, May 12 to 16, 1930, is general manager, Saginaw Malleable Iron division, General Motors Corp., Saginaw, Mich.

Melting equipment consists of three 90-inch shell cupolas; three 10-ton oval-shaped, electrically-tilted forehearths; one 3-ton electric crane to transport the cupola metal to the electric furnaces, and two 3-ton electric furnaces. Two rotary-type blowers furnish the blast for the cupolas. A 10-ton electric crane unloads all the raw materials for melting and places them in the proper storage bins.

The storage space for the various pig irons and scrap is limited, which makes it necessary to keep a close check on the raw materials received. The inventory is kept low, with only two or three days' run in the yard at any one time. The cupolas are lined down to 66 inches and have a melting capacity of 20 tons each per hour. Two of the three cupolas are used daily during normal operation; the third cupola is repaired during the day, and the one used during the day is repaired at night. A complete repair in the melting zone is required at the end of each day's run.

Slag Is Handled Easily

The slag conveyor is at the rear of the cupolas. The molten slag drops from the slag spout into a trough of water. A moving chain in this trough collects the slag at one end of the system, and it is from this point that the slag is hauled away. This arrangement simplifies the handling of the slag and makes conditions more pleasant for the cupola men. Each of the three forehearths holds 10 tons of molten iron, and they are lined with a 9-inch wall.

The two electric furnaces are rated at a 3-ton cold-melt capacity, but they hold from 10 to 12 tons of molten metal. Each furnace has a 1500-kilovolt-ampere, 3-phase transformer which steps the voltage down from 5100 to 115 volts. A demand limiting device was installed recently on one of the furnaces, and it has been found quite successful in keeping down the demand. By close supervision it has been possible to hold the power peak down to the desired point. This has had the effect of holding down the kilowatt-hour consumption, which varies somewhat according to the tonnage.

When operating the furnaces near capacity, the kilowatt-hour consumption per ton of hot metal tapped, which includes about five per cent cold-steel scrap, runs from 92 to 98. When operating at reduced capacity, the power consumption will run as high as 120 kilowatt-hours per ton.

From five to six pounds of graphite electrodes are used per ton of hot

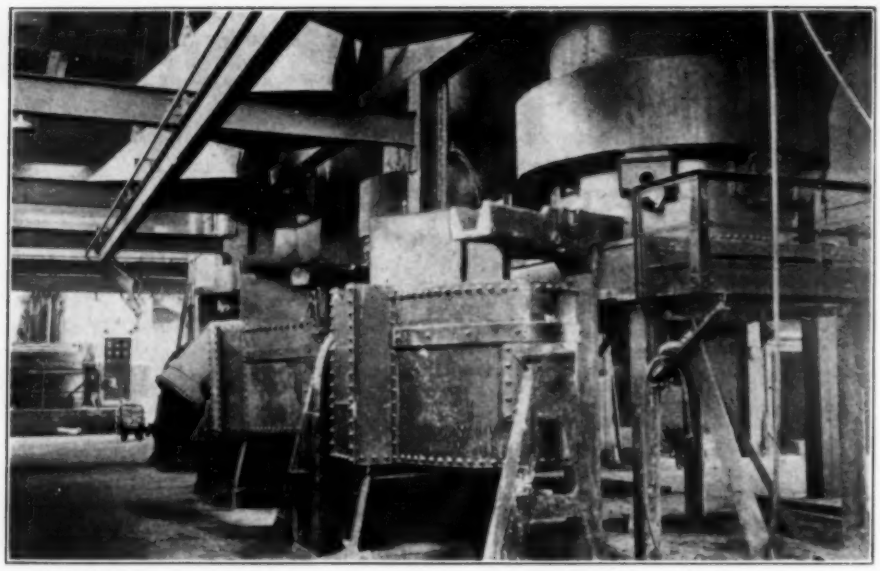


FIG. 1—ARRANGEMENT OF THE MELTING UNITS WITH THE ELECTRIC FURNACE SHOWN IN LEFT BACKGROUND

metal. Scrap electrodes are used for burning-in of holes in the bottom, which is rarely done. Silica brick is used for refractories on the electric furnaces. The life of the roof is from four to seven weeks, during which time 2500 to 5000 tons of molten iron are poured from the furnace. The life of a side-wall is longer in most cases than that of the roof. The bottom is made up of two layers of clay brick, on top of which are fused layers of ganister running about 8 inches thick.

Increase Refractory Life

Proper operation of the furnace is the greatest factor in increasing the life of refractories. The furnace is operated free from slag at all times. To keep the slag off the hot iron, the furnace operator tilts the furnace backward and uses a green pole to remove floating slag from the metal.

A maximum of 425 tons of metal has been poured in 10 hours. The floor space of the present conveyor system is half of what was formerly used for floor molding, with more than double the former production. Since starting the production of the cupola-electric process, a variety of material has been used. At present the company has standardized on two grades of pig iron, alloy-free flashings, pressed steel bundles and rails, besides our hard-iron remelt and soft-iron scrap.

This material is placed in bins, either on the ground or charging floor, by the 10-ton crane. The charge is loaded on steel trucks by the charging crew. These trucks are pushed on a dial scale where the charges are weighed carefully, and then are moved to the cupola charging floor where they are charged manually. Three dial scales are used for weighing the metal charge, and one for the coke charge. The scales are checked hourly by the weigher and all discrepancies immediately taken care of by the proper methods.

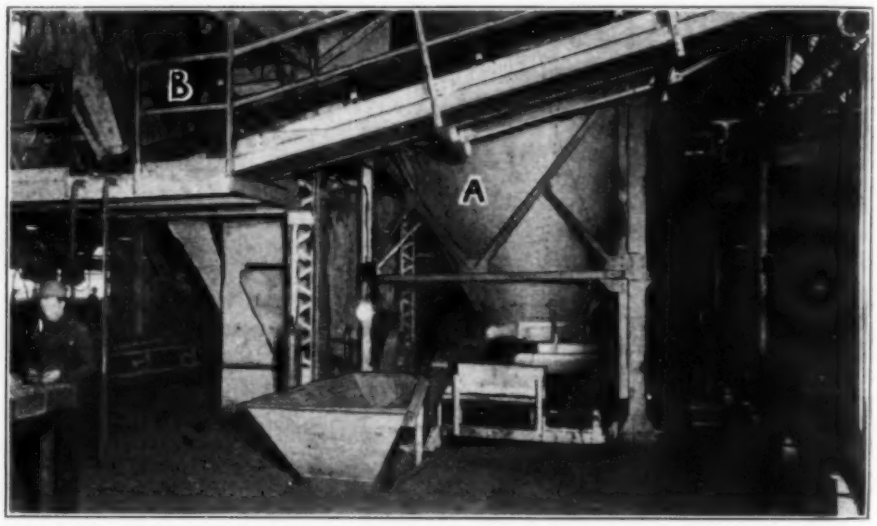


FIG. 3—SAND STORAGE BIN *A* DISTRIBUTES SAND TO TWO UNITS. OPERATOR *B* ON THE PLATFORM ADJUSTS THE MOISTURE CONTENT OF THE SAND

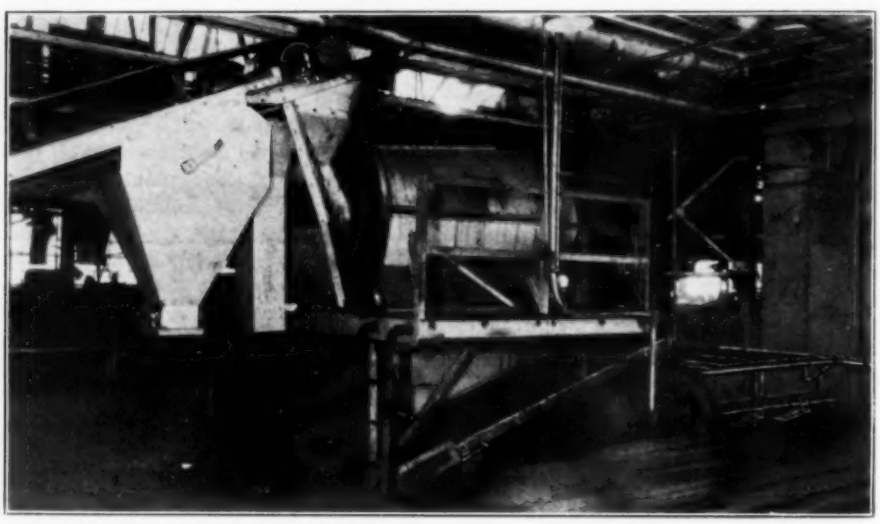


FIG. 2—SAND IS PREPARED FOR USE IN A MAGNETIC SEPARATOR, SCREEN, AND PADDLE TYPE MIXER

Considerable thought has been given to automatic charging, but so far only preliminary work has been done. The nature of the charge differs from that used in most foundries where a large percentage of pig iron is used.

The charge consists of 10 to 12 per cent pig iron, 38 to 40 per cent steel scrap and 50 per cent hard-iron sprue. Most of the steel in the charge is made up of flashings, which are bulky and do not lend themselves to automatic charging as readily as would appear. The coke arrives at the plant in drop-bottom cars, which are unloaded by a skip hoist into a storage bin holding about two and one-half cars of coke. At the bottom of this storage bin are three hoppers, from which the coke is loaded into the coke buggies, weighed and charged

into the cupolas illustrated in Fig. 1.

The cupola bed takes about 4000 pounds of coke, with 320 to 360 pounds between the 4000 pounds of metal charged. Limestone is supplied to the cleaning floor by means of the 10-ton crane. A trip bucket is filled with limestone on the ground, raised to the cleaning floor and shoveled on to the pile used to supply the cupola.

Fig. 1 shows layout of the three cupolas, three forehearths and one electric furnace. A second electric furnace is located on the opposite side of the transformer room. The molten cupola iron flows into the forehearth. Soda ash, which is used to desulphurize the metal, is placed in the spout, melted and washed into the forehearth. The soda-ash slag is allowed to remain on the metal from 1 to 1½ hours before being skimmed off. Approximately 20 per cent of the sulphur is removed by using about six pounds of soda ash per ton of iron treated.

FIG. 5—MOLDS COOL ON THE RETURN TRIP OF THE CONVEYOR AND THEN ARE DUMPED ON THE VIBRATING SCREEN *A*. THE CLEANED CASTINGS DROP IN THE PERFORATED BASKET *B* WHICH LATER IS CONVEYED OUTSIDE TO COOL

FIG. 4—ARRANGEMENT OF THE MOLDING STATIONS SHOWING THE SAND HOPPERS AND MOLD CONVEYORS

Operation of the cupola is similar to that in gray-iron practice, but the blast pressure is somewhat lower, due to the open charge, and averages about eight ounces while melting 16 tons per hour. The maximum blast does not go over 13 ounces at any time.

Temperature of the iron at the cupola spout averages 2800 degrees Fahr. During the time the metal is in the forehearth before being taken to the electric furnace, the temperature drops 100 degree Fahr. during normal operation. The cupola metal is transferred by a 3-ton crane from the forehearth to the electric furnace along the monorail shown in Fig. 1.

The furnaces are filled with molten iron in the morning. When pouring is started, 3 tons of hot iron at about 2950 degrees Fahr. are taken out of one furnace, leaving about 7 tons in the furnace. Three tons of cold cupola metal are added to this furnace and the other is tapped while the furnace receiving the cold metal is getting hot, which takes about four minutes. Three tons of iron from each furnace is poured alternately in this manner until the end of the day, when the furnaces are emptied. By this arrangement a continuous supply of uniform iron is given to the foundry throughout the day.

Close Control Is Necessary

The duplex process for making malleable iron requires close laboratory control of all raw materials and molten iron. This is true of every metallurgical process, but in air-furnace melting formerly carried out in our plant—and which is the practice in other plants—preliminary samples were taken for chemical analysis of the molten iron before being poured into molds. If the analysis was not as desired, the necessary additions could be made before tapping.

It is our practice to take chem-

FIG. 6—TWO POURING STATIONS *A* AND *B* EMPLOY MOVING PLATFORMS FOR CONTINUOUS POURING

ical samples from the cupola iron every 20 minutes throughout the day. The iron being analyzed is poured into molds before the analysis is completed, and the routine analysis therefore serves only as a guide.

The analysis when reported represents iron that was charged in the cupola about one hour and forty-five minutes before. It takes about an hour for the charge to descend in the cupola, 10 minutes in the forehearth and 35 minutes for a complete chemical analysis. Chemical analyses covering carbon, silicon, sulphur, manganese and occasionally phosphorus are made on six samples of iron taken daily from each electric furnace. The analysis of the raw material covers coke, pig iron and the various steels used. From the standpoint of uniformity of cupola operation, quality of the coke is the most important.

We have found that the most reliable routine test for coke is the combustibility test. A fast-burning coke is desired, as it is possible to melt faster and thereby use less coke. A coke with a temperature rise of 250 degrees Fahr. in two minutes requires about 300 pounds of coke per 2-ton charge, while a coke with a temperature rise of 250 degrees Fahr. in four minutes requires about 400 pounds of coke per charge. From the standpoint of quality of iron produced, both cokes will give equally as good metal.

The purpose of the coke testing is to try to get the producer to supply a uniform coke. It readily can be appreciated that uniform cupola operation cannot be expected with a coke showing a variation of two minutes for a 250 degree temperature rise. It is the practice to change the amount of coke used in the charge to conform to the carbon content of the iron which we plan to pour at the spout of the cupola.

On all coke tests, the total temperature rise and ignition point are noted and studied carefully. The combustibility test use for coke is that described by A. L. Boegehold in an appendix to his paper presented at the 1929 meeting of the American Foundrymen's association.

The control of pig iron starts with the study of the iron ore used at the blast furnace. Our metallurgist is at the blast furnace during the time the pig iron is cast, to get all the information necessary for a study of the quality of pig iron produced. The various casts of iron are followed through the melting and annealing processes.

We have found that variation in operation of the blast furnace and composition of the burden bear an important part in production of sound castings which will anneal readily. The machinability of the annealed casting also is dependent to a more or less extent upon the blast-furnace practice and quality of pig iron used.

When the pig iron arrives at the plant, a chemical analysis is made of three pigs from each car, to check the blast furnace results. It was formerly necessary to take the analysis on at least ten pigs from each car, but the blast furnace company has taken steps to produce a more uniform pig iron by pouring casts from a ladle having an 80-ton capacity.

In the duplex process we use various grades of steel. The largest percentage used in the charge is flashings produced at various drop-forge plants. We specify alloy-free flashings, but it is necessary to keep a close watch on this material as it arrives at the plant, because often some alloy flashings are mixed with the plain carbon flashings. This is the only precaution taken on the steel. Rails, sheet bundles, angle bars, boiler plates, etc., do not contain any alloys and the only cause for their rejection is in the case of excessive rusting.

The sand is prepared first by a magnetic separator, screen, tempering belt and paddle mixer. This layout is shown in Fig. 2. Fig. 3 shows the storage tank and distribution of the sand to two molding units. At this point the sand finally is tempered and aerated for delivery to the hoppers over the molding machines.

An operator stationed on an elevated platform regulates the water from that point to hold the moisture in the sand to within 0.1 per cent. He is paid a bonus to hold the moisture content at a fixed percentage. Fig. 4 shows delivery of the prepared sand from overhead hoppers to the flasks by a conveniently located lever. We have a total of 112 molding stations and each station is located alongside one of the molding conveyors, thus enabling the molder to place his completed molds on the conveyor by taking only a few steps.

The molds travel on the conveyor to a pouring zone shown in Fig. 6,

(*Concluded on Page* 90)

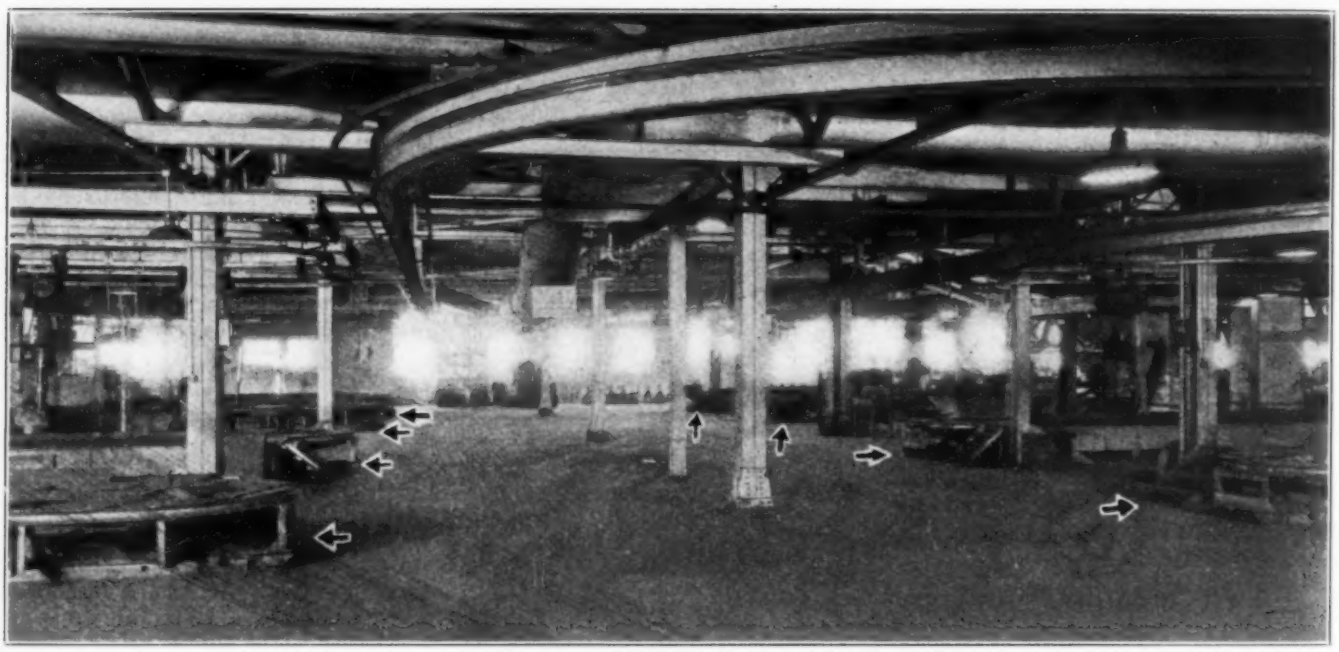


FIG. 7—ARROWS INDICATE THE EIGHT POURING STATIONS ON TWO OF THE MOLDING UNITS. HOT METAL FROM THE ELECTRIC FURNACES IS CARRIED IN ON THE OVERHEAD MONORAIL SYSTEM

Fundamentals of
FOUNDRY PRACTICE

Choice of Flask Material Usually Is Determined by the Character of the Metal Handled—Advantages of Various Types of Clamps Discussed

By Ivan Lamoureux

[Interpreted in the Light of American Practice by Pat Dwyer]

Part X

MANY molds for small castings are stacked and poured while in that position. In such a case, good flasks are indispensable with solidly attached pins and exactly matched, to prevent any possibility of shifting between copes and drags that might cause mismatched joints on the surfaces of the castings.

Flasks are made of wood, wrought iron, steel, cast iron or aluminum. There is no fixed rule for determining the choice of material of which the flasks should be made. Such factors as lightners, durability and utility determine the type of flask used.

All Give Good Service

A flask made with care, will perform satisfactorily regardless of the material. Comparisons should not be drawn between poorly built flasks of one material and well built flasks of another. A structural iron or steel flask, if stiff enough and if the two halves match over their entire surface will give excellent results. A heavy and badly constructed cast iron flask will not permit working conveniently. A light flask with the corners rounded and the joints machined, is quite satisfactory. Aluminum flasks are light, strong enough and convenient to permit molding medium sized castings without the need of mechanical hoists for lifting them. In recent years they have been adopted extensively in nonferrous and ferrous foundries particularly in American shops.

Usually only a cope is required in floor molding. This cope covers the mold and rests on the floor, hence, instead of dowel pins, guide bars or stakes touching the flask are driven into the ground at the corners to locate the cope definitely.

The best stakes are made from the ends of rails, angle iron, square bars or flats, etc. To be really advantageous, the guides should be quite flat and have one end pointed so that they may be driven into their respective locations easily.

The point of the stake should be an extension of the horizontal axis of the body to obtain a perfect entry according to the direction desired. Thus the stake shown at the left in Fig. 101 will be forced in straight according to the direction given by the first blow of the hammer. The stake with bevelled point will follow the prolongation of a line bisecting the angle of the point.

Guides the Cope

Sometimes in a case of urgent need it is necessary to make up some cast iron stakes, but their use is not recommended under normal conditions. To insure an exact lift from the pattern and later, replacement of the cope the guides should extend to a height equal to that of the pattern or mold part above or below the joint. The stakes should lie close to the sides of the cope as shown in Fig. 102. This guide insures a perfect match by allowing just the play strictly necessary to remove the cope and replace it without trouble. In the example of molding shown in Fig. 103 the stake will not guide the cope accurately.

After the guide is driven, it is advis-

Styles in Flasks

NO FIXED rule has been established or can be established for the selection of material used in foundry flasks. Proximity of raw material and relative cost usually are the determining factors. The problem of holding the molds together during the pouring period also gives the foundryman many opportunities for exercising his ingenuity in the development of clamps and weights that can be applied with a minimum of effort, insure satisfactory results, and be removed readily.

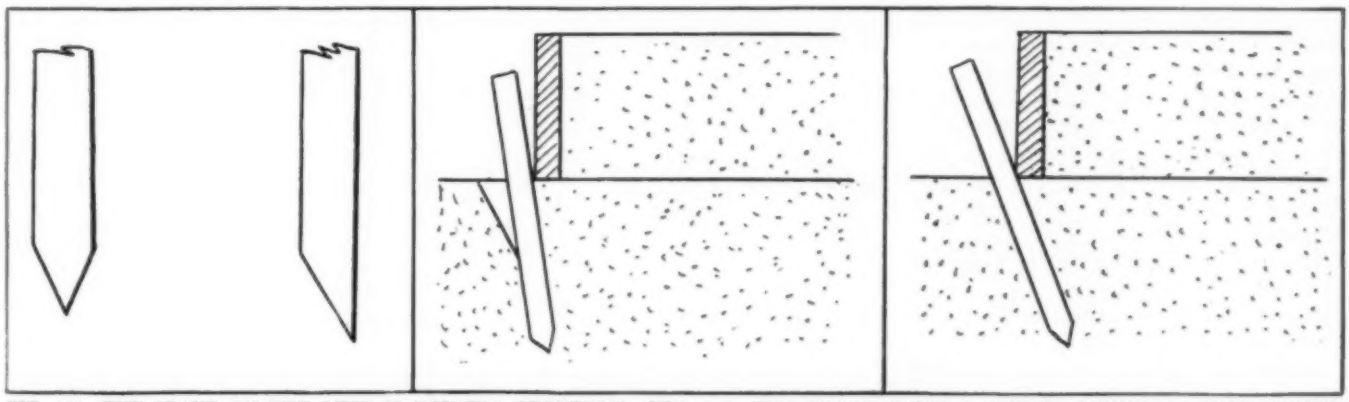


FIG. 101—THE STAKE ON THE LEFT IS POINTED PROPERLY. FIG. 102—THE STAKE WITH A WEDGE BEHIND IT WILL GUIDE THE COPE CORRECTLY. FIG. 103—IMPROPER MANNER OF DRIVING A STAKE

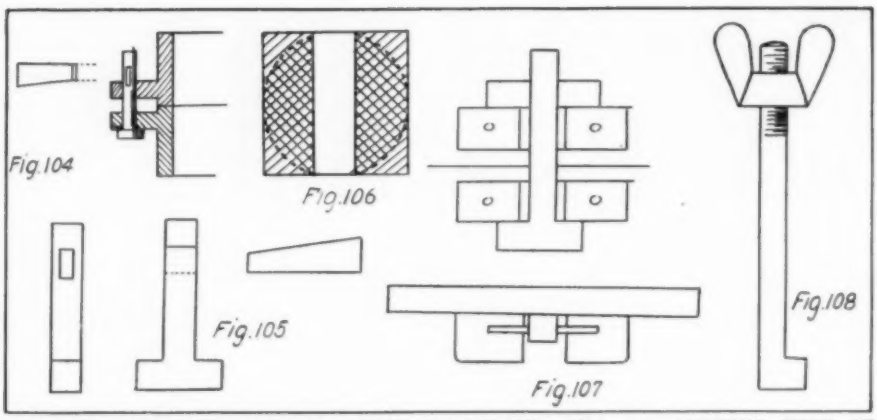


FIG. 104—COTTER PIN ACTS AS GUIDE AND CLAMP. FIG. 105—ANOTHER TYPE OF LUG CLAMP. FIG. 106—SQUARE CROSS SECTION IS THE STRONGER. FIG. 107—APPLICATION OF LUG CLAMP. FIG. 108—CLAMP WITH NUT FOR ADJUSTMENT

able to ram the sand all around it with the butt of the rammer. In some cases it is advisable to drive wood wedges back of the guide stake. Under the action of moisture, the wood will swell and press the guide still more tightly against the flask.

Should Protect Guide

After the cope has been removed each guide should be protected by a small cast iron frame, for example, a small flask or bushing. To insure accuracy in replacing the cope, one always should take care to avoid striking the guides.

In making deep molds in the floor in which the inside has to be swept out after the cope is lifted off, guides are placed at the outside corners of the flask as far as possible from the outside of the mold. This precaution also provides more space around the mold and facilitates setting sweeps or templets. Stakes should not be driven close to any part of a mold where the sand slopes near the joints. Driving the guides compresses the sand of the slopes against the rammed sand of the cope and consequently causes some of the sand to drop.

Where a drag forms an extension to a mold made in the floor it is lined up sideways by the same guides. The four corners should rest on cast iron or steel plates buried in sand. Weights or other blocks, also are used for the same purpose. Before ramming the sand, the molder should assure himself that the flask does not rock. It should rest perfectly flat on its four bottom faces. When lowering the flask, the molder verifies the bearing at the corners by sticking a trowel between the flask and the plate.

The various parts of the flask should be held together firmly by special clamps to resist the pressure developed in the mold at the time of pouring.

Where the dowel pins are provided with mortised holes, as shown clearly in Figs. 91, 92 and 95, tapered flat keys are employed to lock the cope section to the drag half of the flask.

Large flasks have additional lugs reserved solely for the clamping. They

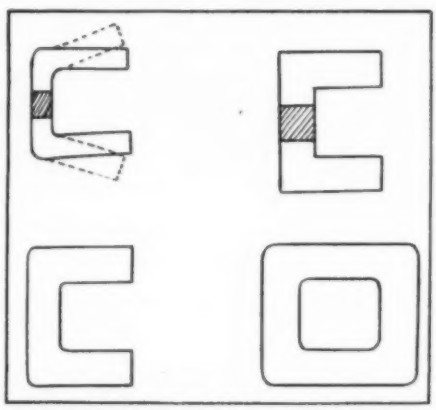


FIG. 109—SPRUNG CLAMP, LEFT ABOVE IS WEAKEST. CLAMP AT LOWER RIGHT IS STRONGEST

are held together by slotted bolts and flat keys as shown in Fig. 104. This system of clamping has one disadvantage. The keys are hard to loosen when the iron runs over from gate or riser and falls in a cascade on the lugs. Under these circumstances the mass is hard to separate. Accidents of this kind also constitute another argument in favor of flasks with slotted lugs. A cast iron round pin is practical in molding with the type of removable dowel pins shown in Fig. 98.

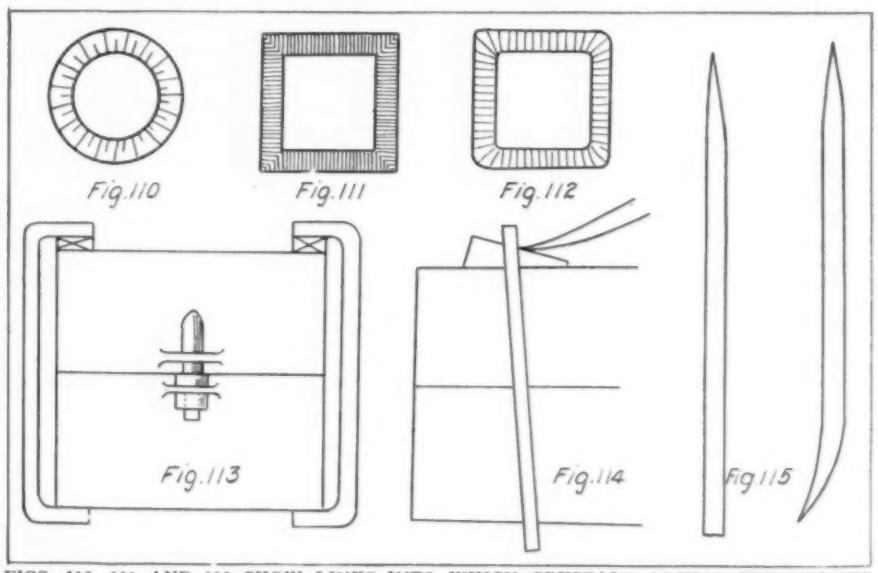
The square cast iron clamps with keys shown in Fig. 105 are much stronger then corresponding round cast iron clamps. In a 1-inch square cast-iron clamp with a slot 1/3 inch wide, Fig. 106 it will be noted that the cross-section at the mortised slot is reduced by one third with a corresponding reduction in strength. In a round clamp with the same sized slot, the strength will be reduced almost half. This feature is illustrated graphically in Fig. 106, which shows a circular section inscribed in a square section.

Gives Advantages of Pins

The square iron pin is provided with a head, Fig. 105, which permits placing the pin right against the flask itself where the lug is strongest. Even if the iron flows over a pin of this kind it may be removed easily without cracking the lugs.

When molding with removable flask pins, the two parts of the flask can be held together with slotted bolts and keys as in Fig. 104, or advantage may be taken of the bolt shown in Fig. 108 provided at one end with a wing nut and at the other end with a sort of short flat hook which can be slipped into the slots in the lugs without completely unscrewing the nut.

A small number of clamps of this type will enable one to cast any number of flasks. As fast as the molds are poured, the clamps are taken off and put on others. The operation re-



FIGS. 110, 111 AND 112 SHOW LINES INTO WHICH CRYSTALS ADJUST THEMSELVES IN VARIOUS CROSS SECTIONS. FIGS. 113 AND 114 SHOW HOW CLAMPS ARE TIGHTENED. FIG. 115—THE CLAMPING BAR

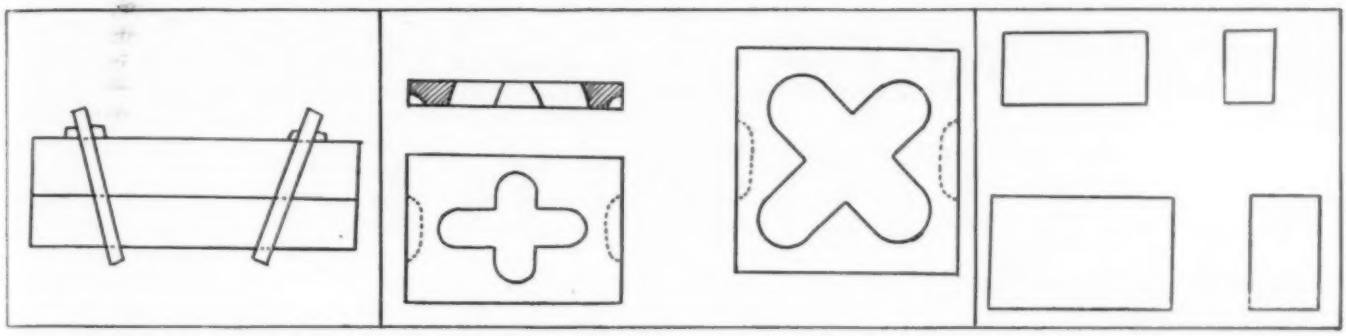


FIG. 116—CLAMPS ARE INCLINED IN OPPOSITE DIRECTIONS. FIG. 117—FLAT IRON WEIGHTS FOR SNAP FLASKS. FIG. 118—CAST IRON WEIGHTS FOR LARGER FLASKS

quires only a short length of time.

Flasks often are clamped by U-shaped pieces of forged iron or steel, 1 1/5 x 1 1/5 to 1½ x 1½ inches as in Fig. 109. These clamps stand up well in service, but some care has to be taken in putting them on. If driven too hard the arms spread out and will not retain a wedge. Clamping under these conditions is uncertain. For clamping small flasks, forged or cast clamps with a V-shaped opening often are used. These are put on without the need of a wedge.

Describes American Practice

American mass production shops favor the use of a small compact flat block with a tapered horizontal slot in the center of one side, wide enough to embrace the lugs or flanges on the cope and drag. At the various clamping points the flanges or lugs show a gradually increasing thickness. The clamp is slipped on where the flanges are thin and then moved toward the thick part. A single horizontal tap of a hammer tightens the clamp in place. A single tap in the opposite direction releases it.

When bolt or key clamps, Figs. 104 and 105, are not available, cast iron clamps are made up, always bearing in mind the fact that at the moment of solidification, cast iron fixes the long axis of its crystals almost perpendicular to the wall of the mold. That is why in the hollow cylinder shown in Fig. 110, the axis of the crystals follows the lines which pass through the centers of the concentric circles. A casting of that kind is homogenous and uniform in strength.

In the casting shown in Fig.111, the crystals arrange themselves in opposite directions at the corners and this tendency greatly reduces the strength of the casting. In the casting shown in Fig. 112, the corners have been rounded to secure a mixed form which is comparatively strong.

In applying this theory to the casting of clamps, the molder looks with little favor on the clamp shown in the upper right of Fig. 109. Cast clamps with sharp corners crack easily. The clamp illustrated in the lower left is stronger than the preceding clamp shown at the upper right in Fig 109 yet whenever possible, the molder should make use of the ring-form clamp as shown at the lower right in Fig. 109, which has decided advantages. Where the U-shaped clamp has to resist bending, the ring-form clamp is subjected to pulling stresses. The clamp represented at the lower right Fig. 109 is twice as strong as the clamp shown opposite at the left. The ring-form clamp completely encircles the lugs of the flask. It stays in place. There is no risk of knocking it off at the slightest blow.

Clamping flasks right at the lugs really is only practical where special ears are made which will not serve for dowelling. In fact this arrangement only applies to large flasks. In the small flasks handled by hand only two or three lugs are available and they are reserved for the dowel-pins.

The use of clamps similar to those represented in Fig. 109 is not recommended in small flasks. It is necessary to attach them at the ends of the lugs, outside the dowel pins where they may loosen at the slightest jolt and even break the lugs when they are tightened. Therefore the long clamps shown in Fig. 113 which clamp the whole flask should be chosen. The cross-section of these clamps is 1 1/5 x 1 1/5 inches for a maximum length of 24 inches and 1 1/5 x 2 inches for lengths from 24 to 40 inches. The corners are rounded to increase their strength.

To properly apply these clamps, it is necessary to place them against the flask with one end under the drag and the other end on top of a hardwood block or maple wedge on the cope as in Fig. 114. A special iron bar, Fig. 115, flattened out and curved at one end and pointed at the other is employed to push the clamp up on the wedge by forcing the end of the bar between the wedge and the clamp as shown in Fig. 114. This method of clamping is practiced universally particularly on green sand molds where the blow of a hammer might loosen the sand. The pointed end of the bar serves also as a rapping bar for the pattern.

Position of Clamps

On small flasks not exceeding 24 x 24 inches two clamps will serve. However, they should be inclined in opposite directions to offer maximum resistance at the time of filling the mold. On flasks measuring around 24 x 31 inches four clamps usually are put on, two on each of the long sides of the flask and inclined as shown in Fig. 116.

Calculating the pressure exerted by the molten iron against the walls of the mold at the time of pouring, is a subject for a special and higher course of instruction. The pressure exerted in a mold depends on the height of the metal in the runner and the area of the cope surface against which it is exerted. Hence no relation exists between the weight of the

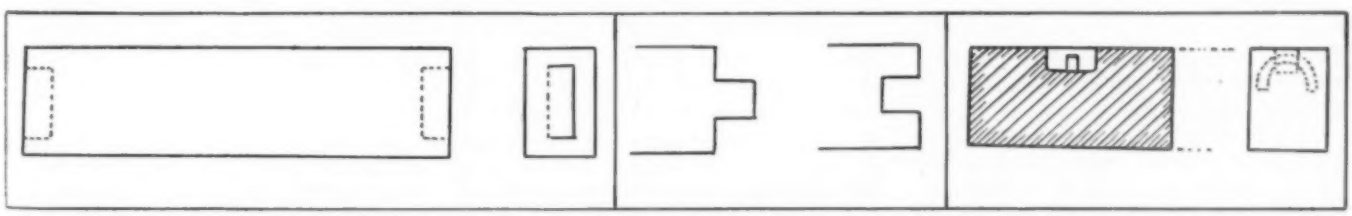


FIG. 119—WEIGHT WITH HAND HOLES IN THE ENDS. FIG. 120—UNDESIRABLE SHAPE FOR WEIGHT. THE PROJECTING ENDS ARE EASILY BROKEN. FIG. 121—TYPE OF LARGE WEIGHT TO BE LIFTED BY THE CRANE

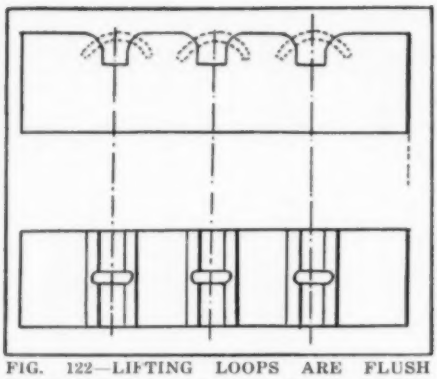


FIG. 122—LIFTING LOOPS ARE FLUSH WITH THE TOP TO FACILITATE PILING WEIGHTS ON TOP OF EACH OTHER

casting in the mold and the weight to be placed on the cope.

Small castings can be molded advantageously in snap flasks made of hard wood and reinforced with metal fittings. They are hinged at one corner and are equipped with snaps or catches on the diagonally opposite corner.

Use Snap Flasks

When the mold is complete the snaps are released and the flask is taken off, leaving the block of sand on the bottom board. Special plates are used for weights on these molds which bear over the entire top of the mold. The types generally employed are similar in shape to those shown in the Fig. 117. The openings are tapered or drafted to facilitate removal of the plates in case the metal runs over. The depressions in the sides of the plates facilitate their ready handling.

It is extremely important for the molder to have available flask poured weights of uniform shape and all having one dimension in common. Thus the weights shown in Figs. 118 and 119 all have one common dimension of 4 inches. This arrangement permits using them indiscriminately for loading comparatively large flasks.

Depressions in the sides or ends of these weights facilitate their handling. They should be in the form of pockets surrounded entirely by iron as shown clearly in Fig. 119. Then they can be piled up promiscously without fear of breakage. If the weights are made up as shown in Fig. 120, they are not quite as strong. The ends are broken easily, and consequently the handling of the weights becomes difficult. The weight shown in Fig. 119 furnishes the maximum bearing surface. It rests on its entire length, whereas in the weights shown in Fig. 120 the extensions on the ends reduce the useful bearing surface.

For loading flasks it is inadvisable to use the odds and ends of scrap iron found about the foundry. These irregular masses injure the workmen's hands and do not rest evenly on the flask. Furthermore, when these scrap pieces become dirtied from use, it is impossible to differentiate between them, to distinguish their grade of iron or to use them to any advantage in the composition of the mixtures to be melted.

Many foundrymen still use weights without lifting eyes or of cylindrical form. They are hard to pile up without running the risk of causing a catastrophe. The fact that the weight of these irreguler masses is not always known, may result in wrong estimates and always cause accidents.

Good elongated weights of uniform size, rectangular or square with countersunk pockets for lifting, greatly facilitate operations at the time of casting, and to a great extent contribute to the successful operation of the foundry. With large, as with small weights, it is advisable to adopt one common dimension for all. A set of uniform weights facilitates considerably the loading of large molds in which a number of weights have to be piled up. The lifting eye shown in Fig. 121 is countersunk in the iron at the bottom of a hollow. The height of these weights is 15 inches. The weight shown in Fig. 122 has three grooves which permit quick and easy hooking of the crane chains. The eyes are sunk slightly below the top face of the weight. The height of these weights also is 15 inches.

No Risk in Piling

All these weights can be used for loading one flask. No risk is incurred in piling them one on top of another. Furthermore in some instances on account of their length no rails are needed under them. Two small weights similar to that shown in Fig. 119 or any two small blocks will serve.

The only objection to weights in which the lifting loops are cast in, is that if through any cause, the loops are broken, they cannot be replaced. The style of weight shown in Fig. 123 has no loops or other parts to become worn or broken. It presents the least difficulty in molding. It may be molded either in open sand or under a cope and may be made in any convenient length. The illustration shows a weight 12 inches square, 9 feet in length and weighing about 4000 pounds. It is provided with two loop holes for the hooks on the crane chains. A shorter weight of the same cross section and weighing about 2000 pounds is handled by a single hook attached to the 1½-inch diameter steel pin which is passed through the opening provided for that purpose in the weight. Each vertical opening extends completely through the weight from top to bottom and in that way no dirt can collect in it. The steel pins are loose. In service the chain hook is dropped into the opening vertically. The steel pin is inserted horizontally. To detach the chain all that is necessary is to pull the pin out.

When preparing to weight a large mold a number of good straight rails weighing at least 60 pounds per running yard will be required. Rails used for this purpose never should be used for supporting fires on sheet iron. The high temperatures burn the metal and weaken it. On exceptionally long molds steel I-beams can be used to advantage.

Shims of varying thickness often are needed to adjust a weight, a flask or a core. As a general rule, one should choose small sheet steel shims, or wide pieces which are much safer than cast iron plates. Hard wood wedges should be used to clamp the rails before loading the molds. For clamping them after loading, steel wedges should be used.

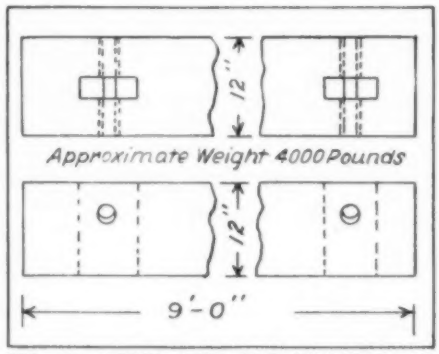


FIG. 123—STEEL PINS ARE INSERTED OR WITHDRAWN TO ENGAGE OR DISENGAGE CHAIN HOOKS

Metal Congress To Be Held in Chicago

The National Metal congress and exposition for 1930 will be held at the Stevens hotel, Chicago, from Sept. 22 to 26. The following societies will hold their annual fall meetings in conjunction with the congress: Institute of Metals division, and the Iron and Steel division American Institute of Mining and Metallurgical Engineers; Iron and Steel division, Machine Shop Practice division, American Society of Mechanical Engineers. The annual convention of the American Society for Steel Treating will be held during that period and the fall meeting of the American Welding society will also be in session at the Congress hotel.

Driver-Harris Co., Harrison, N. J., has changed the location of its Chicago office from West Randolph street to 1138-40 West Washington boulevard.

Questions & Answers on FOUNDRY PRACTICE

GRAY IRON

Adds Alloy to Iron

QUESTION

We are contemplating the production of castings from gray iron with the following analysis: Silicon, 1.85 to 2.35 per cent; sulphur, under 0.09 per cent; phosphorus, 0.30 per cent; manganese, 0.65 to 0.90 per cent; chromium, 0.30 per cent, and nickel, 1 to 1.5 per cent. Can you give us any information on the best method of making this composition?

ANSWER

In making the mixture you desire, you have a choice of several methods to accomplish the addition of the alloys. One method is the use of nickel shot and ferrochromium. The ferrochromium should be the high carbon 70 per cent grade and ground to 8 or 12 mesh. To obtain the desired amounts of chromium and nickel, it will require about 7 ounces of ferrochromium and from 17½ to 26 ounces of nickel shot per hundred pounds of metal. One method of adding these alloys is to place them in a paper bag. Have good hot metal and as soon as the bottom of the ladle is covered with molten iron, drop the bag containing the alloys at the junction of the stream and the metal in the ladle. Another way is to have a funnel just above the stream at the spout. The alloys drop through the funnel into the molten metal issuing from the spout.

Another method of adding the required quantity of alloys to your mixture is to employ a nickel-chromium alloy which contains 5 parts of nickel and 1 part of chromium. About 5 ounces of this material added to the ladle as previously described will bring the alloys to the desired point. A third method is to use a chromium-nickel bearing pig iron which is melted in the cupola with the rest of the charge. However, since your desired nickel content is 3 to 5 times that of the chromium content, a further addition of 1 per cent nickel will have to be made in the ladle. This is based on using about 19 per cent of the nickel-chromium pig iron in the mixture. You may have to use more or less of the pig iron indicated than that mentioned depending upon the loss of chromium during the melting operation.

THIS department covers all problems relating to metallurgical, melting and molding practice encountered in making steel, malleable-iron and gray-iron castings. Questions submitted by bonafide subscribers to this department will be answered by members of the editorial staff of The Foundry, supplemented where occasion requires by the advisory staff whose personnel is as follows:

John H. Hall—Cast Steel
H. A. Schwartz—Malleable Cast Iron
J. W. Bolton—Gray Cast Iron

All questions should be addressed to The Editor, The Foundry, Penton Building, Cleveland.

Q & A

Wants White Iron Data

QUESTION

I have charge of a foundry that is planning to enter the white iron casting field. I have had considerable experience on malleable and steel, and would like to brush up on white iron.

ANSWER

White cast iron should offer no difficulty to you since you have had experience with malleable cast iron and with steel. Similar to malleable, white iron must be melted hot and handled quickly from the melting unit to the mold. White cast iron solidifies a relatively few degrees under its melting point. You do not state what thickness your castings will be so it is not possible to give any except a general range of elements. The silicon in such castings will run from 0.50 to 1.20 per cent; sulphur as low as possible; phosphorus from 0.30 to 0.60 per cent with a tendency toward the low value; and manganese, 0.40 to 0.60 per cent. The lower silicon ranges will be used in the heavier castings and the higher values for the lighter types of castings that you intend to manufacture.

The cupola charge may be composed of chilled car wheel scrap, white iron scrap, malleable pig iron and steel scrap. These may be used in varying amounts to obtain the desired results. About 25 per cent steel scrap will give a good strong iron if the other components are balanced properly. Sometimes gray iron scrap is used to give higher silicon in the mixture. One mixture used for small grinder disks or burrs was composed of 40 per cent malleable pig iron (1 per cent silicon); 15 per cent gray iron scrap (2 per cent silicon); 20 per cent white iron scrap (0.85 per cent silicon), and 25 per cent steel scrap. This gave an iron containing about 0.70 per cent silicon and, so far as we know, gave good results.

Plenty of coke should be used between charges to provide the necessary superheat desired with this type of iron. Try an iron to coke ratio around 5 or 6 to 1. Put a good bed in the cupola and see that it extends about 36 inches above the top tuyeres. You probably will find that your first iron will come down in about 6 to 8 minutes after the blast is turned on. If the first iron comes down sooner than this increase the height of the bed, and vice versa. You also will find that you probably will get hotter iron by using small charges instead of large ones. If you have a 36-inch cupola, an 800-pound charge should give good results. A mixing ladle should be employed at the cupola spout to insure a more uniform metal for pouring. This ladle should have a capacity of at least one iron charge. Pattern-

maker's shrinkage for white iron is given as ¼-inch per foot.

Q & A

Nickel Loss Is High

QUESTION

Recently we began adding nickel shot to our gray iron, and we seem to have a high loss of this ingredient. We have followed the instructions of our supplier in adding the nickel at the spout, allowing it to drop 15 to 18 inches into the metal. Although we do not have any temperature measuring device, we try to get the iron as hot as possible. Our difficulty may be shown in the following example: On our last heat we carefully calculated the mixture to give a nickel content of 1.4 per cent, but the analysis showed only 0.75 per cent. While we expected a loss, this was much beyond our expectation. This is only one of several instances with such results.

ANSWER

Extended experience in addition of nickel to gray iron and steel convince us that nickel is not lost during such additions, and if the iron is sufficiently hot, the nickel is dissolved completely and distributed evenly throughout the metal. The following sources of error should be examined:

Is the material you are adding substantially pure nickel? Cupro-nickel containing 50 per cent nickel and monel metal containing 70 per cent nickel resemble nickel quite closely. The other component of the alloys is mainly copper. Presence of copper may be determined by dissolving a small amount of the material in 1 to 1 nitric acid. When cool add an excess of strong ammonia. A *deep blue* color indicates the presence of copper. Nickel will give a light blue which easily is distinguished from the blue of copper.

Nickel shot contains slightly over 90 per cent nickel; the remainder being iron and silicon. Therefore, each 1 per cent addition of nickel shot will give about 0.90 per cent in the mixture. To obtain 1.4 per cent nickel in your castings, add about 24½ ounces of nickel shot per 100 pounds of molten metal. This assumes, of course, that you have little or no nickel in your cupola return charges.

It is easy to miscalculate the amount of molten metal in the ladle. Any amount in excess of that estimated naturally reduces the percentage of nickel in the whole. The best method is to weigh the molten iron as well as the nickel. However, the cubic capacity of the ladle can be calculated easily. Measure the diameter of the top and bottom of the ladle and take the average as the diameter for calculating the volume of the ladle. Since cast iron weighs about 0.26 pound per cubic inch, you can determine the quantity of iron a ladle will hold.

A third error may be in the correct determination of the nickel content. The most accurate method is that employing dimethyl-glyoxime, and modified for iron analysis. The cyanide titration method may give erroneous results in hands unaccustomed to this method. You might have your analysis checked by some reputable consulting laboratory, or works laboratory familiar with nickel determination.

GENERAL

Gives Sand Mixtures

QUESTION

Can you give me a good dry sand mixture using: (a) A crushed silica rock; (b) Pittsburgh loam; (c) Millville gravel. Also can you tell me if it is possible to buy an iron low in phosphorus. Present phosphorus in our castings runs between 0.40 and 0.50 per cent and I should like to reduce it to 0.15 or 0.20 per cent.

ANSWER

Millville gravel and Pittsburgh loam are naturally bonded sands containing sufficient clay to form a hard body when the mold is dried in the oven. For heavy castings, or where the mold surface is exposed to thick bodies of metal at high temperatures, the facing may be all new sand. For medium weight and light castings the facing may contain as low as 20 per cent or as high as 50 per cent new sand. The remainder is old molding sand and the mixture may be prepared in any type of recognized sand mixing device. Where the natural bond is reduced through the use of a large proportion of old sand, the loss may be made up by the addition of a small quantity of clay, a little dry core binder, or, by wetting down the mixture with molasses water or any of the water soluble liquid core binders. Naturally the amount to use will depend on local conditions. With too little, the sand will crumble and wash before the metal. With too much, the escape of gas will be retarded. The face of the mold will scab and the castings will contain blisters and blow holes. If you already are using the ground silica rock we assume it is not a pure silica but contains sufficient bonding material to render it usable as a molding material in the natural state. Probably a little artificial binder is all that is required to convert it into a suitable material for forming dry sand molds.

Generous use of steel in the charge will lower the phosphorus content in the resulting iron. Low phosphorus pig iron may be secured from any of the pig iron supply houses listed in the advertising pages of THE FOUNDRY. It is the variety used for making steel by the bessemer and acid open hearth process, for making malleable iron castings and it is also used extensively in the gray iron castings of the automotive industry.

Q & A

Line With Firebrick

QUESTION

I am interested in making a heat-resistant, cast-iron door that will withstand 2000 degrees Fahr. I have had difficulty in the past in that the doors will not stand up. The door is for a tile kiln furnace. It is 16 by 24 inches and can weigh 150 pounds. I only melt scrap, but it is a good grade.

ANSWER

Ferrous materials that will withstand such temperatures as you refer to are those containing high percentages of chromium or chromium and nickel. We suggest that you make a frame type door such as used on open-hearth furnaces. These doors are lined with firebrick, and stand up quite well. The frame part of the door should be about 1-inch thick and 2 inches deep. This will allow the regular 2½-inch brick to extend ½-inch beyond the door proper. The metal of the door itself should also be about 1-inch thick with two vertical and two horizontal ribs about 1-inch thick across the back. Be sure and fillet all re-entrant angles to prevent cracking.

Silicon in the metal should be lower than that generally used for your regular run of castings. While white iron will withstand heat better than gray iron, it has the disadvantage that is somewhat brittle, and cannot be machined. Therefore, we suggest that you reduce the silicon to a point where you obtain a mottled fracture instead of gray or white. As you may surmise, this type of iron will have properties between the white and gray irons.

Q & A

Decide Average Loss

QUESTION

We melt between 8 and 9 tons of iron daily in a foundry employing 18 molders on a general line of small and medium size machinery castings. What is the average loss on this class of castings. That is the direct loss in defective castings?

ANSWER

A plain and direct answer to your question would be that the average percentage of defective castings in light and medium work gray iron foundries operated on an efficient basis is 5 per cent when taken over a monthly or yearly period. In-

(*Continued on Page* 73)

The FOUNDRY Family Photograph Album

Upper Left

W. J. MUHLITNER

Great Lakes Foundry Sand Co., Detroit, Mich.

Upper Right

R. S. ARCHER

Aluminum Co. of America, Cleveland

Lower Left

W. H. WARREN

Fuller & Warren Co., Troy, N. Y.

Lower Right

C. W. VEACH

Bettendorf Co., Bettendorf, Iowa

SPECIFICATIONS FOR STEEL CASTINGS

FOR VALVES AND FITTINGS FOR HIGH TEMPERATURE SERVICE

1. These specifications cover carbon-steel castings for valves, flanges and fittings for high-temperature service.

2. The steel shall be made by the electric-furnace, open-hearth or other process approved by the purchaser.

3. (a) All castings shall receive a heat treatment proper to the design and chemical composition of the castings.

(b) Heat treatment, unless otherwise specified by the purchaser, may consist of annealing, or of normalizing, or of normalizing followed by annealing, or of normalizing followed by a drawback to a temperature below the critical range. No castings which have been quenched in any liquid medium shall be offered under these specifications.

(c) Annealing.—The procedure for annealing shall consist in allowing the castings to cool, after pouring, to a temperature below the critical range. They then shall be reheated uniformly to the proper temperature to refine the grain and allowed to cool uniformly in the furnace.

(d) Normalizing.—The procedure for normalizing shall consist in allowing the castings to cool, after pouring, to a temperature below the critical range. They then shall be reheated to the proper temperature to refine the grain and allowed to cool in still air.

4. The steel shall conform to the following requirements as to chemical composition:

Element	Per Cent
Carbon	0.15 to 0.45
Manganese	not under 0.50
Silicon	not under 0.20
Phosphorus	not over 0.05
Sulphur	not over 0.05

5. An analysis of each melt of steel shall be made by the manufacturer to determine the percentages of the elements specified in Section 4. This analysis shall be made from drillings taken at least ¼-inch beneath the surface of a test ingot obtained during the pouring of the melt. The chemical composition thus determined shall be reported to the purchaser or his representative and shall conform to the requirements specified in Section 4.

6. Analyses may be made by the purchaser from the broken tension test specimen or from a casting representing each melt. The chemical composition thus determined shall conform to the requirements specified in Section 4. Samples for analysis shall be taken not less than ¼-inch beneath the surface, except in the case of castings which are too thin, and shall be taken in such a manner as not to impair the usefulness of the casting.

Abstracted from Standard Specification A95-29 of the American Society for Testing Materials.

(*Continued on Data Sheet No.* 814)

SPECIFICATIONS FOR STEEL CASTINGS

FOR VALVES AND FITTINGS FOR HIGH TEMPERATURE SERVICE

(*Continued from Data Sheet No.* 813)

7. (a) The castings shall conform to the following minimum requirements as to tensile properties:

Tensile strength, lb. per sq. in.	70,000
Yield point, lb. per sq. in.	36,000
Elongation in 2 in. per cent	22
Reduction of area, per cent	30

(b) The yield point shall be determined by the drop of the beam of the testing machine at a cross-head speed not to exceed ⅛-inch per minute. The tensile strength shall be determined at a speed not to exceed 1½ inches per minute.

8. (a) Bend tests shall be required for castings only when so specified in the order.

(b) When a bend test is specified, the test specimens shall stand being bent cold through an angle of 90 degrees around a pin 1 inch in diameter, without cracking on the outside of the bent portion.

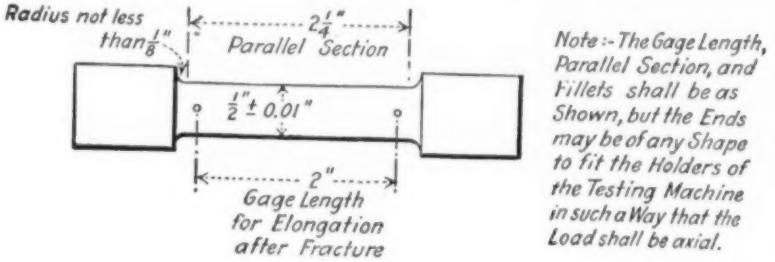

Radius not less than 1/8"
2 1/4"
Parallel Section
1/2" ± 0.01"
2"
Gage Length for Elongation after Fracture
Note:-The Gage Length, Parallel Section, and Fillets shall be as Shown, but the Ends may be of any Shape to fit the Holders of the Testing Machine in such a Way that the Load shall be axial.

FIG. 1.

TENSION TEST SPECIMEN

9. Each casting shall be tested after machining to the hydrostatic pressures specified in the following table (Note 1), and shall show no leaks. Castings ordered under these specifications for working pressures other than those listed below, shall be tested to such pressures as may be agreed upon:

Class of Castings, Working Steam Pressure, Lb. Per Sq. In.	Standard Test Pressure, Lb. Per Sq. In.
250	750
400	1000
600	1500
900	2000
1350	3000

(*Continued on Data Sheet No.* 815)

THE FOUNDRY DATA SHEET, MAY 15, 1930

Payment will be made for all contributions on foundry and pattern shop practice suitable for publication

(*Continued from Page 70*)

stances are on record of foundries where the casting loss is held to 2 or 3 per cent, but they are exceptional. Those with 7 to 10 per cent losses are more common. Sometimes the cause of heavy losses is quite apparent to any intelligent person. On other occasions it can only be discovered and remedied by a man who has had an extended practical experience and who is familiar with the principles underlying the art of casting metal into molds. It may lie in the sand, in the metal, in the equipment, in the methods employed or in the degree of skill possessed and exercised by the employes. All these factors are variables and either singly or in almost infinite combination may be responsible for defective castings. In fact unless all these variable factors are synchonized perfectly, the resulting castings will go to the scrap heap.

MALLEABLE

Gives Iron Mixture

QUESTION

Will you please advise us what the proper mixture of iron would be to produce malleable castings having a tensile strength of 50,000 pounds per square inch and an elongation of 15 per cent? In our yard we have pig iron containing 1.30 per cent, 1.40 per cent and 1.60 per cent silicon. We also have railroad malleable scrap and sprues from previous melts. We are using a natural draft furnace.

ANSWER

An answer to your question involves factors which you do not give, namely the percentage of sprues your operations produce, and the carbon and silicon you lose during melting. The latter two may not be constant and therefore, you must have some analytical supervision to keep you informed of the facts.

If you know these facts proceed as follows: The final product should contain in the hard iron, about 2.50 per cent total carbon, and this is the carbon content of your sprue. Let A be the sprue produced in percentage of the melt, and let B be the per cent carbon lost in melting. Then you must have in the mix, 2.50 + Y carbon. It follows that

$$\frac{A}{100-A} = \frac{X-2.50-B}{B}$$

which when solved for X gives the mean carbon content of all the mix except the sprue. If X be greater than the carbon content of pig iron (about 4.1 per cent) you cannot use up all your sprue.

Assume that the carbon content of the pig to be 4.1 per cent, and that the railroad malleable, 1.9 per cent, and let Y be the amount of pig iron in *pig iron plus scrap*, not in percentage of the whole mix. Then

$$\frac{Y}{100-Y} = \frac{X-1.9}{4.1-X}$$

from which X having been found, you may compute Y and the percentage composition of the mix will be

Sprue = A
Pig = 0.01 (100-A) Y
Scrap = 0.01 (100-A) (100-Y)

Assume that the oxidation loss of silicon is C. The silicon content of your metal will depend somewhat upon your casting sections. It may be perhaps 0.80 per cent. Then in the mix you require 0.80 + C per cent silicon. Designating the required silicon content as Z, this value may be calculated from

$$\frac{A + 0.01\ (100-A)\ (100-Y)}{0.01\ (100-A)\ Y} = \frac{Z-0.80-C}{C}$$

You may select any combination of pig iron which will average the required silicon values. For your guidance it may be said that usually the mix will come out somewhat as follows: Sprue, 50 per cent; pig iron, 40 per cent; scrap, 10 per cent; silicon in the pig iron, 1.60 per cent, but the figures will vary depending on your particular conditions.

STEEL

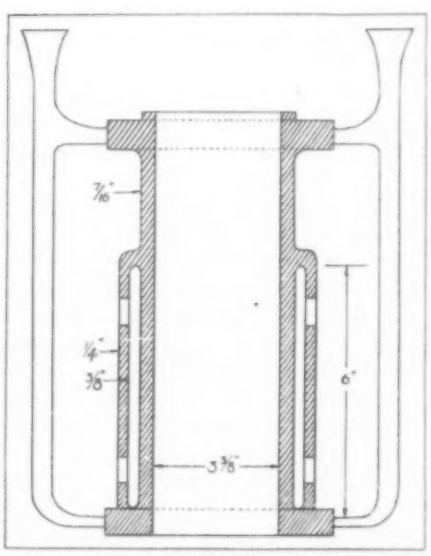
Blows from Jacket Core

QUESTION

We are enclosing sketch of small cylinder in which the water jacket core is causing trouble through blowing. We use a mixture of 1¾ cubic feet of lake sand bonded with 1½ quarts of pure linseed oil. The casting is poured on end from two ladles.

ANSWER

On a volume basis your core mixture works out at about a ratio of 1 part oil to 35 parts sand and that is considered high. You do not give any particulars on how the core is made and assembled or how the vent is conducted away. In all probability the core is made in halves and pasted. The cores which serve the double purpose of supports for the main jacket core, and openings for the water connections, are made separately and either pasted to the jacket core or placed in the prints. A thin dab of paste is applied to insure a free passage for the vent from the jacket core through these supporting cores. It may be that these print cores are made integral with the halves of the jacket core. In that case the only paste required is a little along the edges where the two halves of the jacket core are joined. Reference to these features is made because with every other factor in your favor, the small amount of extra gas produced by the paste, may be responsible for all your trouble.



THE CASTING IS POURED ON END FROM BOTH SIDES

The most satisfactory method of making this thin jacket core, is to make it all in one piece on end in a cylindrical corebox open at both ends and with the center part removable. The outside part is split in two longitudinally and also contains recesses for forming the prints. After the sand is rammed, the center plug is removed, the cavity is filled with molding sand and then the two halves of the corebox are withdrawn. A few vent wires may be rammed up with the sand, one in front of each of the prints, and removed before the corebox is removed. Under exceptionally favorable circumstances this amount of venting will be sufficient, but as a precautionary measure you may find it advantageous to run a thin strand of wax vent among the wire vents near the top end of the core. The foregoing refers to one possible contingency.

Another possibility exists that your sand contains lime or other impurities and in that event no possible manipulation will produce a satisfactory core. The first and principal requirement is a clean sharp sand with maximum permeability. To this must be added a minimum amount of binder to reduce the amount of gas developed during the pouring process. The core must not be rammed hard and it must be dried almost to the point of burning. Naturally, cores of this kind require careful handling. Pure boiled linseed oil is an excellent core binder, but excellent results are secured from core oils specially prepared by foundry supply interests. These oils contain other ingredients which experience has shown improve the linseed when used for this particular purpose.

Problems in Nonferrous Founding

By Charles Vickers

Adds Iron to Brass

We recently made a brass mixture of 60 pounds copper wire; 40 pounds block zinc and 4 pounds of auto spring manganese steel. The molten metal appeared white hot when the crucible was taken from the furnace, and while apparently in liquid form the metal would not pour into the mold, clogging up gate and running possibly a third of the casting. After the metal was allowed to stand awhile, it took on a reddish hue, and the pouring improved. The castings however, were rough and porous, and the outer surface showed deep depressions due to shrinkage. We removed a lot of white dross from the metal before we could pour. We are at a loss to under why the castings failed to come out as they should, as we are fairly successful in making brass.

The metal acted in the peculiar manner outlined because it is its nature to do so. If only 30 per cent zinc has been put into the copper, then the alloy could have been cast, although it would be far from what is known as a good casting metal, as the castings would likely be wormy on the surface to a larger or greater extent, according to how they were poured.

The 4 per cent of iron did not improve the casting qualities of the 60-40 brass because in trying to get it incorporated, no doubt there was oxidation of the metal finally resulting in zinc oxide inclusions, which always make nonfluid metal. The white dross skimmed off was zinc oxide. It is a bad thing to allow to get into the molds because it makes holes in the castings. Never try to alloy steel of any kind, manganese or not, with copper or brass or bronze, for it will be melted with difficulty, if at all. If it does, it will diffuse throughout the copper as little nodules or droplets, so when the casting is solid it contains steel inclusions. Steel and cast iron contain carbon, with which copper will not alloy. The next time this experiment is tried, proceed as follows: Weigh out 58 pounds of copper; 40 pounds of zinc; 1½ pounds of clippings from tinplate and add ½ pound of aluminum to the mixture.

Melt the copper, covering it with charcoal, and get it hot enough to look blue when the charcoal covering is pushed aside with a poker. Coil up the tinplate loosely and push it under the surface of the melted copper with tongs. Keep dabbing at it with the poker until it disappears. Then stir, and add the ½ pound of aluminum. Leave it alone for 5 minutes. Then take a small piece of zinc and drop it into the copper and stir, after which all the zinc can be added. The metal will not need to be hot enough to smoke to any extent when it is removed from the furnace. It should look oily on the surface when poured.

Q & A

Gives Molding Data

We have attempted to cast a solid bushing, 4 inches diameter and 12 inches long, in 90-10 aluminum bronze. We have melted the copper and aluminum then ingoted the bronze and remelted for the castings. In every instance after machining, there are defects in the bar. The castings had a smooth appearance before machining. Also, we have tried to cast the same size bushing, only in lengths of 2 to 2½ feet, in pure aluminum, and also the No. 12 alloy, but after machining there are fine specks in the bars. We have poured from the bottom, also from the top with similar results. We melt in crucibles, flux with zinc chloride and pour at from 1250 to 1300 degrees Fahr. by pyrometer.

The aluminum bronze solid bushing will cast clean when molded horizontally, and not vertically. The gating and risering is important. In making the mold allow not less than 3 inches of sand over the pattern in the drag, so the bronze will lay quiet in the mold. When the casting is too near the bottom board or plate, the gas is held and the metal will boil more or less. Also provide well for the escape of gases. This also applies to the aluminum. Locate the sprue at one end of the bar, but set it so there will be a right angle turn in the runner. Cut the gate deep and narrow, ⅜-inch is wide enough. Cut it deep, or from the joint to the bottom of the drag so the bronze enters on a level with the lowest point of the mold. On the opposite end of the bar place the riser, but locate it on top of the bar. Have the riser rectangular in shape and locate it on the bar with its greatest length parallel with the same, and bush it up 4 inches higher than the cope. For pouring, incline the mold, 3 or 4 inches, according to the length of the flask. The sprue must be high enough to permit a two-thirds filling of the riser when the sprue is full. The flask is inclined with sprue at the lowest point. Pour the bronze in a slow, steady stream at about 2100 degrees Fahr. When the sprue is filled, cover it over with molding sand. Then bed on a weight, and commence to dribble the bronze into the riser. Do this as slow as possible to keep pace with the shrinkage as well as possible.

The aluminum bars can be molded the same way, using higher sprues and risers than for the bronze as the aluminum is only one-third as heavy. The molds should be well vented. The cooler the aluminum can be poured the better it will be for the castings. Adjust the temperature for these castings, so the white metal reflects no red, but is a silvery white. Then take the temperature for future reference. The quicker the aluminum solidifies after pouring the better. A dry sand mold will give better results than a green one in this case. If green sand must be used, needle-vent the mold well, and work the sand as dry as consistent with proper molding, but it can be dryer than for ordinary work. Have the aluminum lie perfectly quiet in the mold. No shivering next the mold sides is permissible. Also it should congeal quickly before it can dissociate any steam, and absorb the hydrogen. This makes the pinholes as it diffuses throughout the aluminum as tiny bubbles. Aluminum also is sensitive to agitation while entering a mold. It is better to avoid splashing, bounding back from mold walls, and the impinging of streams.

Fig. 1—The battery of centrifugal pipe casting machines is located in a long building with the cupolas on one side and the annealing ovens on the opposite side

Machines Spin 10 Miles

of Cast Pipe Daily

BY PAT DWYER

A COMPARISON of the costs involved in the production of cast iron pressure pipe by the four principal methods now in vogue, obviously is outside the scope of the present series of articles. Many variable factors including intermittent operation, cost of equipment, and depreciation enter into the problem to such an extent that any comparison of costs would have to be taken over a period of several years. That this feature still is in abeyance is indicated by the fact that only one interest has gone over definitely to one of the new methods. Companies engaged in the production of cast iron pipe by the centrifugal method, either in steel molds or in sand lined iron molds, still operate the pits in their plants where pipes are cast vertically in dry sand molds containing loam cores.

However, complete unanimity of opinion prevails on which is the fastest method; and is, the method for producing the greatest tonnage over any given period and on a given floor space. This distinction belongs to the so called deLavaud process by which molten iron is poured into spinning steel molds and converted into pipe at at rate of approximately 40 lengths per hour. The hourly production depends on the size of pipe. Manifestly the smaller machines can be serviced faster than those which require greater quantities of iron. On exceptional occasions it is claimed that 60 lengths of 4-inch pipe have been produced from one machine in an hour.

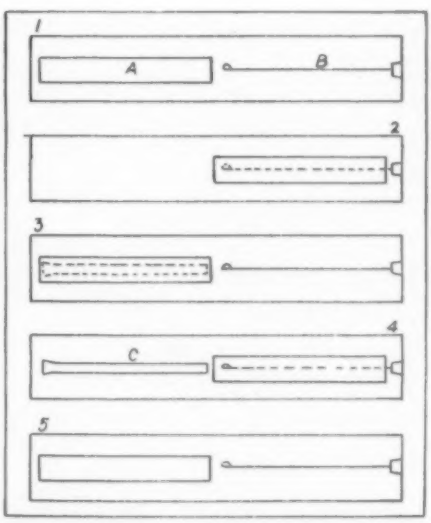


FIG. 2—DIAGRAM OF MOLD MOVEMENT IN THE PRODUCTION OF EACH PIPE

In this connection it is interesting to note that in the pit casting department of the United States Pipe & Foundry Co., Birmingham, Ala., a recent large order for 48-inch pipe for the city of Albany, N. Y., was turned out at the rate of 32 lengths per day. Up to the present, no deLavaud machines in this country have been built for producing pipe larger than 20 inches in diameter and 18 feet in length.

The United States Pipe & Foundry Co., Burlington, N. J., with plants in Anniston, Bessemer and Birmingham, Ala., Cleveland and Addyston, O., Chattanooga, Tenn., and Scottdale, Pa., owns the right to the deLavaud process in the United States and has installed batteries of deLavaud units in the Burlington and Birmingham plants. They have also sublicensed James B. Clow & Sons, Chicago, National Cast Iron Pipe Co., Birmingham,

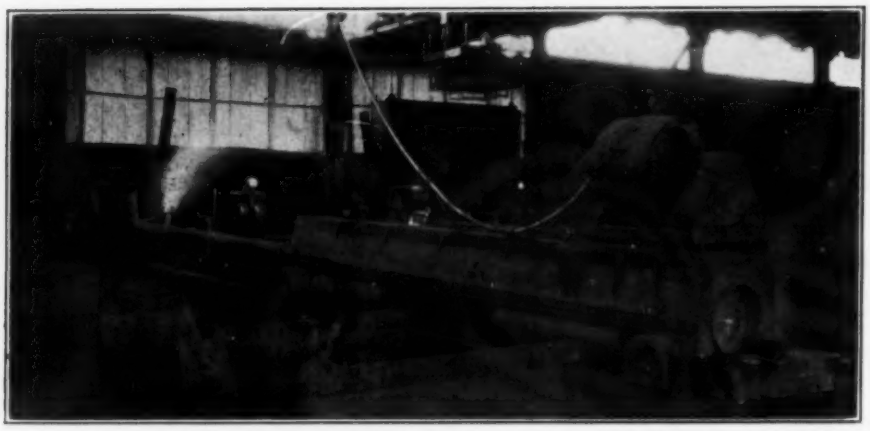


FIG. 3—AN ELECTRIC MOTOR MOUNTED ON TOP OF THE CASING IMPARTS THE SPINNING MOTION TO THE STEEL MOLD ON THE INSIDE

and the Lynchburg Foundry Co., Lynchburg, Va., to manufacture pipe by this process.

Before taking up a description of the practice at the centrifugal plant of the United States Pipe & Foundry Co. at Birmingham, a few brief and general statistics on the deLavaud process are pertinent.

Since 1922 when the deLavaud pipe first was manufactured in this country, the annual production and consumption have increased steadily and rapidly. Manufacture of deLavaud pipe is not confined to the United States. The process has been adopted in Canada, England, Germany, Belgium, Japan and Australia.

A comprehensive article on the history and development of centrifugal casting by J. D. Capron, president, the Glamorgan Pipe Co., Lynchburg, Va., and formerly research engineer, U. S. Pipe & Foundry Co. was presented in the July 15, 1927 issue of THE FOUNDRY.

Describes Process

The following brief synopsis of the deLavaud process will prepare the reader for a more detailed description of the equipment, and of the methods practiced at the Birmingham plant of the United States Pipe & Foundry Co.

The pipe is cast in a cylindrical metal mold slightly inclined from the horizontal, surrounded by hot water and rotating at a comparatively high velocity. The mold is capable of longitudinal movement over a fixed trough which, when the mold is in a position ready for casting, extends down the barrel of the mold nearly the full length, to the bell end, which is the first part of the mold to receive the metal.

The only core used is a small head core, which serves to properly form the inside contour of the bell when making bell and spigot pipe. Iron is fed into the trough from a tilting ladle mounted at the back of the trough. This ladle is so designed that when moved about its point of pivot, a constant uniform delivery of iron is maintained from the ladle into the trough.

At the beginning of the casting operation the mold is rotating at a predetermined speed but is stationary in a longitudinal direction. When the bell is formed, the mold is moved longitudinally in relation to the fixed pouring trough.

Molten iron from a spout at the lower end of the trough flows tangentially on to the mold surface and is held against the side of the mold by centrifugal force. The molten iron is laid in the mold in a continuous spiral stream to form a homogenous pipe. The iron solidifies almost immediately. The time varies slightly according to the size and thickness of the pipe, but the pipe is withdrawn from the mold almost immediately after the pouring ceases. At a temperature of approximately 1100 degrees Fahr. it is placed in an annealing furnace where it is raised to approximately 1700 degrees Fahr. and where it remains a suitable time to eliminate the slight surface chill and to insure the removal of any possible strains in the metal.

These pipe must conform to the close and rigid United States government master specifications for centrifugally cast iron water pipe, known as specification No. 537. This specification covers dimensions, weights and tolerances on all sizes and classes to which the government specifications apply. The clause covering types, classes and sizes is illustrated in the following table, which also gives the working pressure in pounds per square inch:

Class	Working Pressure Lbs. per Sq. In.	Sizes
50	50	All sizes
100	100	14″ to 20″ incl.
150	150	All sizes
200	200	8″ to 20″ incl.
250	250	4″ to 12″ incl.

The inside diameters of the bells and the outside diameters of the spigot ends of pipe shall not vary plus or minus from the tabulated dimensions by more than 0.06-inch for pipe 12 inches and less in nominal diameter and by more than 0.08-inch for pipe of 14 to 20 inches nominal diameter, inclusive.

Gives Pipe Tolerances

Tolerance in thickness, plus or minus, shall not exceed the following:

Nominal diameter in inches	Tolerance, plus or minus, inch
4	0.04
6	0.045
8	0.05
10	0.055
12	0.06
14	0.08
16	0.08
18	0.08
20	0.08

One pipe per shift of each size shall be selected before coating. From each sample pipe there shall be cut and machined one test strip 12 inches long, 0.5-inch deep and the full thickness of the pipe in width. This shall

FIG. 4—A GRIP ON THE INSIDE OF THE BELL END HOLDS THE PIPE WHILE THE MOLD MOVES AWAY. STEEL SKIDS SUPPORT THE PIPE AS IT EMERGES

be tested as a beam (with machined surfaces top and bottom) on supports 10 inches apart with load applied at two points 3 1/3 inchs from supports.

The strip shall be accurately calipered at point of rupture and stress calculated by the formula

$$S = \frac{Plc}{6I}$$

The secant modulus of elasticity at the breaking load shall be calculated by the formula

$$E = \frac{23Pl^3}{1296Iy}$$

In these formulas *S* represents modulus of rupture; E, modulus of elasticity; P, total load; l, length of span; c, distance to extreme fiber; I, moment of inertia; y, center deflection at load *P*.

For deLavaud pipe the secant modulus of elasticity shall not exceed 15,000,000 pounds per square inch, with the modulus of rupture not less than 40,000 pounds per square inch.

Subjected to High Pressure

Each length of pipe is subjected to a hydrostatic pressure of 500 pounds per square inch. The pipe is kept under this pressure for at least 30 seconds and is subjected to a hammer test while under pressure. Any pipe showing a defect is rejected.

At well distributed points upon the machined edge of each test strip, not less than three rockwell determinations are made with t 1.59 mm (1/16") ball under a 100 kilogram load. The average rockwell number must not exceed 95. Shore scleroscope readings shall not exceed 30 when taken with a portable type instrument on the outside of each pipe after it is taken from the annealing furnace.

The specification covers many other features not necessary to enumerate at this time, but which in the aggregate would seem to indicate a standard of perfection outside the range of practical attainment. That this standard of perfection can be attained is shown by the fact that pipe are made by this process in ever increasing quantity.

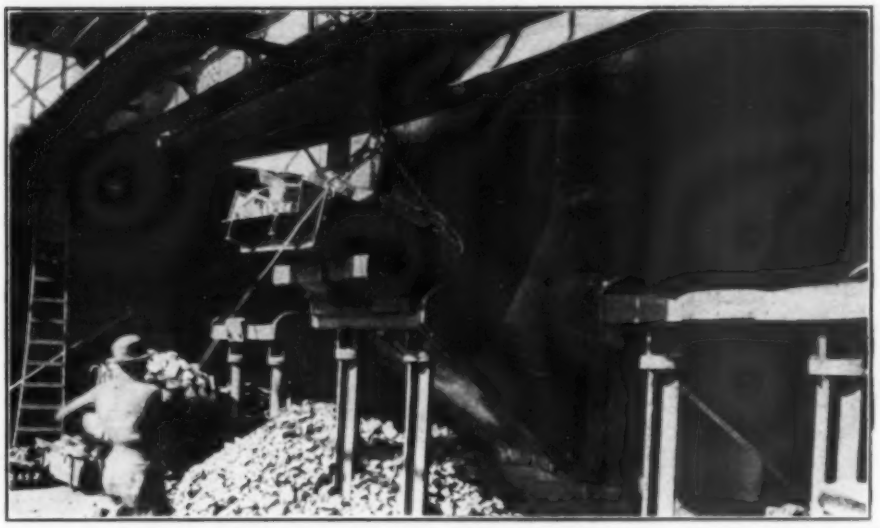


FIG. 6—A CRANE PICKS UP THE LOADED PANS IN THE YARD AND CHARGES THE MATERIAL DIRECTLY INTO THE CUPOLAS

The centrifugal division of the United States Pipe & Foundry Co. in Birmingham is housed in the original plant built by the Dimmick Pipe Co. in 1901. A later shop on the same property built by the same interest for the manufacture of large size pipe in pits, still is devoted by the present owners to the same purpose. The pipes are molded and poured vertically in dry sand molds with a loam core in the center of each. By this process a single casting may be made each day in each flask.

In the centrifugal process a single mold will produce from 270 to 450 lengths of pipe, depending on the size, in a 9-hour day. With 11 machines operating constantly on sizes from 4 to 20 inches inside diameter, the daily potential capacity is approximately 10 miles of pipe. Nine of the machines are equipped to handle pipe in 12-foot lengths. The four newest and largest machines at one end of the battery are equipped to produce 4, 6, 8, 10 and 12-inch pipe in 18-foot lengths.

Explains Many Sizes

The apparent discrepancy of 11 machines producing pipe in 9 diameters, 4 to 20 inches, inclusive, is explained by the fact that two and in some instances, three different size molds may be handled by each machine. The volume and character of the orders determined the molds which are to be used in the machines at any given period. The bearing mechanism in the machines is adjustable within certain limitations so that molds of various diameters are held truly central during the spinning operation. This, of course, is one of the most important features connected with the centrifugal process. The mold must be balanced absolutely to revolve at high speed around an imaginary center. Either vibration, or variation in movement from a true circle, soon would wreck the machine. Also, either of these disturbances would prevent a uniform distribution of molten metal over the inside of the mold surface. Each mold is a special alloy, heavy steel forging accurately machined inside and out and tested for balance. Raised bearings or collars on the outside rest in suitable bearings in a heavy, rigid cast iron container made up of two parts. The lower part is mounted on four side wheels that travel on a base bolted to a concrete foundation and the upper part is removable to facilitate insertion and removal of the molds.

A mold for a 6-inch pipe costs ap-

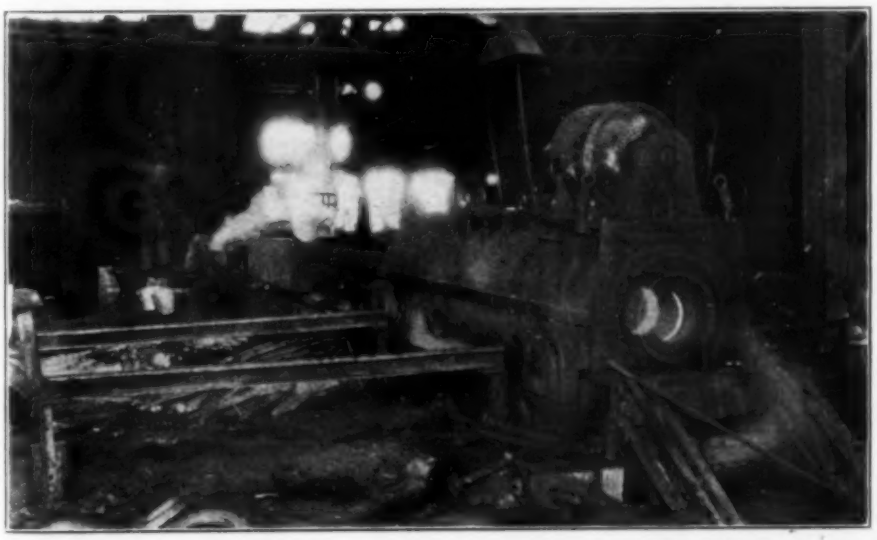


FIG. 5—ONE OF THE MOLDS JUST AFTER THE METAL HAS BEEN POURED INTO IT AND BEFORE IT STARTS ON THE RETURN JOURNEY TO RELEASE THE PIPE

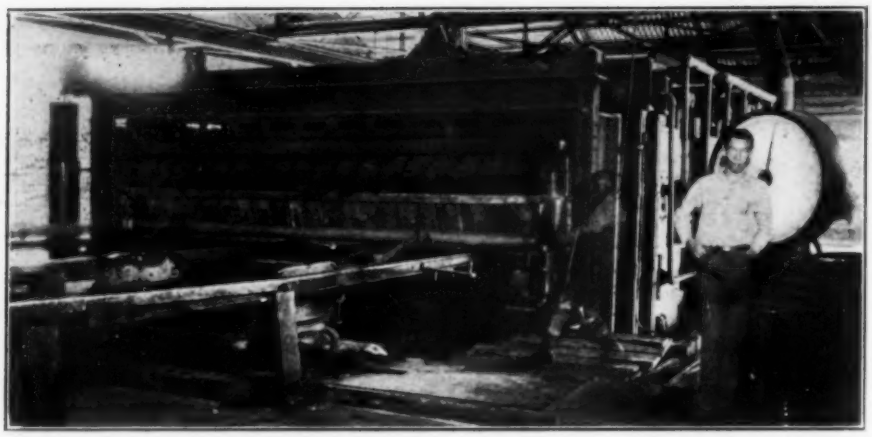


FIG. 7—PIPES ARE INSPECTED AND WEIGHED BEFORE THEY ARE PLACED IN THE ANNEALING FURNACE

proximately $1000 and under normal operating conditions will produce from 2500 to 4000 pipes before it has to be scrapped, due to growth and the development of small cracks on the surface. The cracks interfere with the rapid removal of the pipe after it has been cast and also affect the appearance of the surface which normally is perfectly clean and smooth.

Experience has shown that many factors, temperature of the metal, temperature of the mold, constant or intermittent operation, removal of the casting, composition of the mold, character of the coating, exert an important influence on the life of the mold. Close supervision is required to hold these various factors at the highest point of efficiency. The research department constantly is engaged in investigation and checking equipment and operating features with a view toward further improvement.

In the early installations, the mold was revolved by a stream of water under high pressure directed against a Pelton wheel attached to one end of the mold. In the later models, as may be noted in the accompanying illustrations, the mold is revolved by an electric motor mounted on top of the hood of the machine at the end opposite to where the metal is introduced from the pouring basin. The longitudinal motion of the machine still is affected by a hydraulic cylinder and plunger.

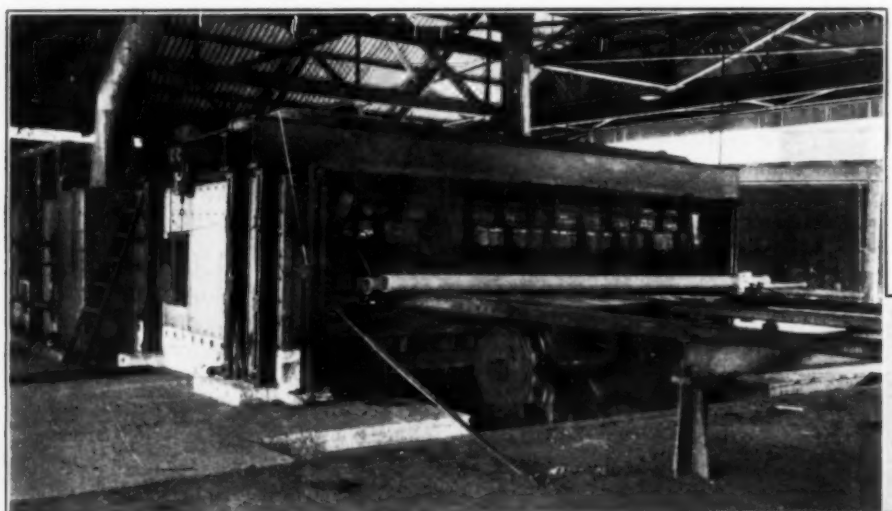
The various controls are located at one side of the pouring end of the machine where one operator stands. He pours the iron, moves the mold backward and forward and starts and stops the motor which spins the mold.

Water is kept in circulation inside the casing in which the mold revolves. Water enters and leaves through telescoping tubes which adjust themselves to the movement of the mold on the foundation. Experience has determined the most satisfactory operating temperature for the mold. It may be regulated to some extent by increasing or decreasing the volume of water, but principally it is controlled by the number of pipes that are cast per hour. The time necessary to manipulate the mold between heats usually is sufficient to prevent the temperature of the mold from becoming too high.

Describes Mold Movement

Graphic representation of the manner in which the mold is operated is shown in the illustration Fig. 2. In the first position the empty movable mold *A* with bell core in place, is shown at the left and the fixed pouring through *B* is shown to the right. In the second position the mold has been advanced to its limit of travel to the right. Metal from the pouring basin runs through the trough to a point close to the bell end of the mold. After a momentary pause while the bell is filling, the revolving mold commences to move to the left and in that manner a continuous stream of metal is discharged in a spiral from one end of the mold to the other end.

The metal solidifies almost instantly, but it remains liquid long enough to prevent any cold shuts or streaks in its spiral path. Occasionally a slight



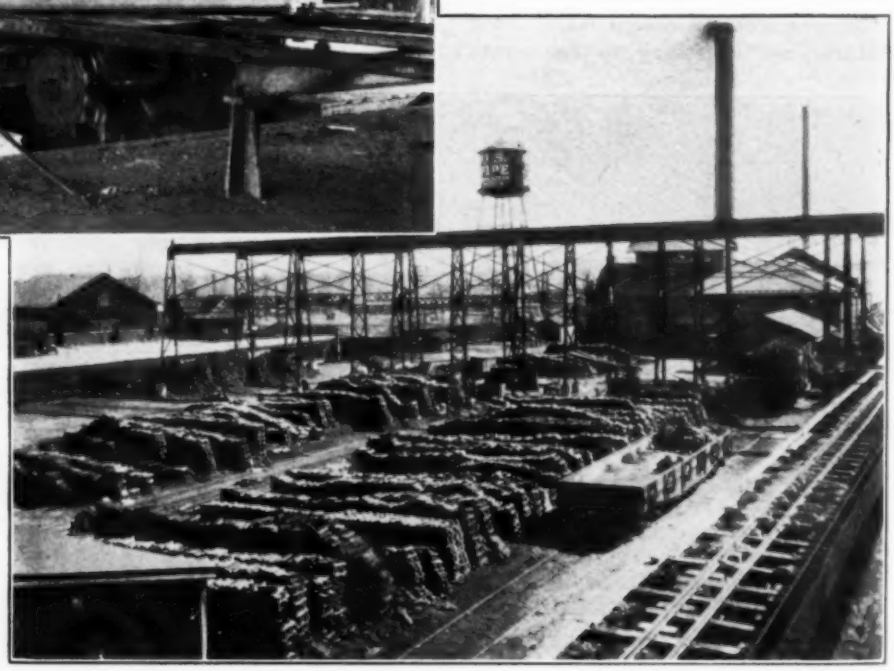


FIG. 8—(ABOVE)—A SPROCKET CHAIN WITH PROJECTING FINGERS MOVES THE PIPES THROUGH THE ANNEALING FURNACE. FIG. 9—(RIGHT)—THE STOCKYARD WITH THE TWO CRANE RUNWAYS AND THE POWER HOUSE AT THE FAR END

surface indication of the spiral may be traced on the finished pipe, but usually the entire surface is clean and uniform.

Immediately after the metal has been poured, the spinning motor is shut off and the mold with the pipe inside is moved to the limit of its travel toward the left as shown at stage 3. An operator standing at the end inserts an expanding grip inside the end of the pipe. This grip holds the pipe while the mold once more is moved to the right. As the mold moves away, a pair of skids are erected automatically to receive the pipe. The skids swing in from either side. By an ingenious automatic device they are depressed to permit the mold to move forward and backward on every occasion, except when the pipe is to be deposited. Then they spring into position and support the glowing casting while the operator rolls it on to a set of permanent skids to one side of and clear of the machine.

Applies the Blacking

Stage 4 of the operation shows the pipe on the skids and the mold again at the extreme right, that is in the pouring position. However, metal is not poured at this stage. An operator applies a swab of blacking to the spout. This keeps the spout clean and prevents the metal from sticking to the lining. The blacking dries instantly in the hot spout. A few pounds of metal left in the spout after it emerges from the spinning mold flows into a small basin provided near the end of the machine for this purpose. Later these small fragments of scrap are collected and taken up to the cupola charging door.

The hot pipe is picked from the skidway by a special two-hook device suspended from a crane made by the Harnischfeger Corp., Milwaukee. At this stage the pipe is at a bright red heat and must be handled carefully to prevent distortion. A spreader keeps the hooks the proper distance apart and a turnbuckle in each chain facilitates making minor adjustments so that each size pipe that is lifted may be held perfectly horizontal.

Pipes are annealed in five annealing furnaces, fired with gas and located in a line close to the side of the building. In fact the opening of each oven is on a line with one wall of the building. The furnace extends into the yard for a distance of 100 feet. One furnace handles the 18-foot lengths, while four furnaces are provided for handling the 12-foot lengths. The 18-foot furnace shown in Figs. 7 and 8 represents the latest

FIG. 10—AN AUXILIARY SPOUT MOUNTED ON A SWIVEL CONDUCTS METAL TO LADLES ON THE RIGHT AND LEFT ALTERNATELY

ideas in construction and operation. Perfectly straight skid lines extend from end to end of the furnace and on these skids the pipes are moved forward and kept rolling by fingers on two sprocket chains located underneath and driven by a motor located to one side of and near the discharge end of the furnace. A long, narrow flap door in a great many sections guards the entrance to the furnace and a similar door helps to maintain the temperature while the pipes are passing out at the discharge end.

Under normal operating conditions the pipes enter the annealing furnace at a temperature of 1100 degrees Fahr. In their passage through two thirds of the distance they are raised to 1700 degrees and then are allowed to cool down to a temperature of 900 degrees before they emerge at the far end of the furnace upon a skidway leading to the grinding, chipping, inspection, dipping and shipping stations.

An automatic control device regulates the mixture and the volume of gas and air in the various burners to maintain a practically uniform temperature in the furnace. Pilot lights on a board near the office indicate actual conditions at various points in the furnace at any given time. Charts on suitable recording instruments furnish a record of the temperatures and fluctuations, if any, over a given period.

Melts the Iron

Iron for the pipes is melted in a battery of four cupolas 62 inches inside diameter, made by the Whiting Corp., Harvey, Ill., and located at the center and outside one of the side walls of the building. These cupolas are operated in pairs on alternate days and are served on the inner or pouring side by two 5-ton cranes made by the Harnischfeger Corp., Milwaukee.

Four other cupolas, part of the

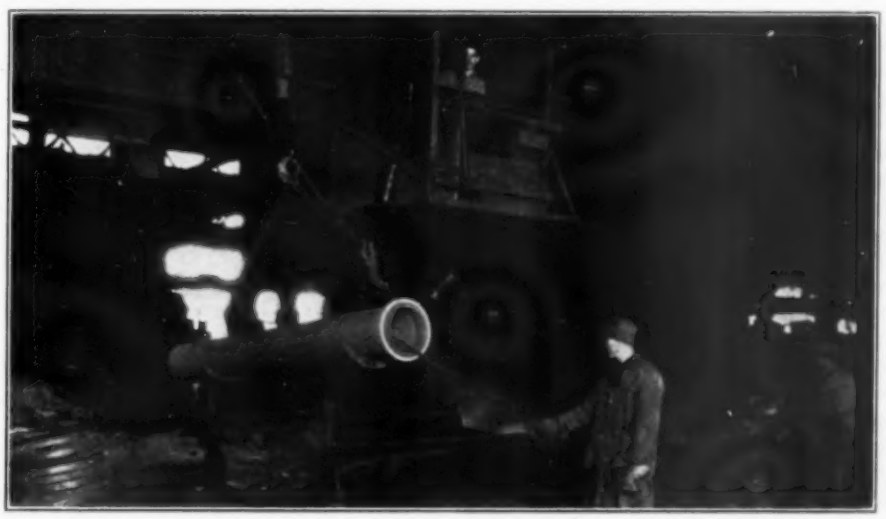


FIG. 11—A SPECIAL CHAIN AND HOOK DEVICE IS EMPLOYED IN TRANSFERRING THE HOT PIPES FROM THE SKIDS TO THE ANNEALING FURNACE

equipment employed when this building was operated as a pit shop, still remain at one end of the building and constitute a spare melting unit. They are served by a monorail which extends over the pouring ends of the various pipe machines.

The stock yard is spanned by two 5-ton cranes which lift the loaded pans and discharge the contents directly into the cupola through a heavy cast-iron chute extending upward in front of the charging opening. Above the charging zone the cupola shell is contracted to 40 inches, a rather unusual feature in American cupolas where the shell usually is uniform in diameter from the foundation plate to the spark arrester. The cupolas in this plant are lined with iron blocks instead of the usual fire brick for a distance of 4 feet below the sill of the charging door. In this area the heat is not excessive, but the abrasive action of the descending stock is severe. It is claimed that the iron block lining gives excellent satisfaction. Blast for each pair of cupolas is furnished by a positive pressure blower mounted on the mezzanine floor and made by the P. H. & F. M. Roots Co., Connersville, Ind. The blast pressure is held to about 11 ounces.

A long spout in front of each cupola is mounted on a pivot so that ladles on either side may be filled alternately without stopping the stream. Each of the ladles holds 2 tons and therefore may be handled rapidly.

This is the fourth of a series of articles dealing with the cast iron pipe industry in the South. Succeeding articles are scheduled for publication in early issues of The Foundry.—The Editors

Foundry Groups Hear British Expert

IN A pre-convention tour J. G. Pearce, director of the British Cast Iron Research association, Birmingham, England, has appeared before the New England Foundrymen's association, the Detroit Foundrymen's association, the Quad-City Foundrymen's association, the Chicago Foundrymen's association, the Wisconsin Gray Iron Foundry Group and the St. Louis District Foundrymen's club. In New England the meeting addressed by Mr. Pearce was held at Everett where the plant of the General Electric Co. was inspected by the New England foundrymen. The Detroit meeting was the annual meeting of the association and was largely attended by foundrymen throughout the district. Russell Scott, Packard Motor Car Co., presided. New officers were elected for the ensuing year.

Addresses Are Varied

Mr. Pearce's addresses before the various organizations were varied slightly and were amplified depending upon matters of local interest. Many interesting points were brought out in the discussion.

In describing the work of the research association which he heads, Mr. Pearce said that a large number of the representative foundries in England are members, but that membership is in no way compulsory. The association which was established in 1921 really has been active only since 1924 and is a strictly noncommercial organizations co-operating with universities and industrial research departments of different companies. So far, the chief lines of investigation have been molding sand, cupola practice and metallurgy. Mr. Pearce described molding sand tests and sand practice among English foundries in considerable detail. He said that because the natural sand there is much finer than the usual deposits in America, they have resorted to alluriation or water current separation in place of the more common sieve method used here. Milling, he said, is almost universal in England. It is found that this improves both the strength and the permeability of most sands.

Permeability of course is affected by density of ramming and is a factor of fineness although theoretically the permeability should not vary with the degree of fineness. The factor in this case is the greater frictional resistance in the case of more finely divided particles. The British permeability test methods do not work on a standard ramming density, but consider the ratio of weight to volume and this relation ranges from 1.4 to 1.9.

In speaking of strength tests, Mr. Pearce gave some interesting information on dry sand experiments. It has been found that the strength varies in identical samples when these are air dried, heated in an oven which is started cold or when they are placed in a hot oven to start. The highest strength is found in the air dried samples. Strength also varies with the degree of temperature obtained in baking.

Permeability Tester Described

He described a simple instrument for measuring the permeability of foundry sand which has been designed by his research association. The instrument uses city gas and sells to members at $30. The permeability value is the inverse of the time required for gas to pass through a rammed test sample. Curves based on varying sand properties were shown on the screen and described.

The speaker commented favorably on the general American practice of using low pressure blast in the cupola. Experiments have been made with a new type of cupola which Mr. Pearce was unable to describe at this time, but which is said to give a coke ratio as high as 19 to 1. This gives 6½ to 7 tons of iron per hour from a 40-inch diameter cupola which is a low melting rate but produces metal at about 2600 degrees. Fahr. The tuyere ratio on this cupola is about 5 to 1, a single row of tuyeres being

Detroit Group Elects New Officers

AT THE annual meeting of the Detroit Foundrymen's association held Friday, May 2, Jesse D. Stoddard, Detroit Testing Laboratory, chairman of the nominating committee presented the names of the new officers. These were unanimously chosen for the succeeding year. These officers are as follows: President, James L. Mahon, American Car & Foundry Co.; vice president, Peter W. Mulder, Almont Mfg. Co., Almont, Mich.; secretary, W. J. Muhlitner, Great Lakes Foundry Sand Co.; treasurer, Fred A. Cowen, Warner R. Thompson Co. The following were elected members of the executive board: Fred J. Walls, Wilson Foundry & Machine Co.; Harry Rayner, Dodge Bros. Inc.; Vaughan Reid, City Pattern Works; J. A. Moore, Acme Foundry Co.; Russell Scott, Packard Motor Car Co.

President Fred Erb of the American Foundrymen's association spoke briefly of the forthcoming American Foundrymen's convention.

used at the correct height to produce preheating. These tuyeres are rectangular and flare outward toward the inside of the cupola on the long dimension.

The British Cast Iron Research association is co-operating with the National Federation of Iron and Steel Manufacturers, which is another English research body, and together they are attacking problems of corrosion resisting materials, coke properties and the use of alloys with cast iron. Much work has been done with nickel and chromium additions and success has been obtained for several alloys by reduction of the silicon in the mixtures.

Considerable work has been done by the British association on the problem of growth. Mr. Pearce announced that this problem seems to have been solved through the production of low silicon, low carbon iron. The relationship of transverse and compression strength to tensile strength is another problem under investigation. British testing engineers use round bars of different diameters for different types of castings. Details of test methods and the observations of the British association will be presented in the international exchange paper which Mr. Pearce is to present at the American Foundrymen's association convention in Cleveland, May 12 to 16.

Sand Producer Installs Laboratory

SAND research work on an extended scale now is well under way in a laboratory recently established and equipped by the Industrial Silica Corp., in the McClymonds building, Massillon, O. The corporations operates 15 plants in various parts of Ohio and Pennsylvania and this central laboratory will serve as a clearing house and a bureau of general information for the corporation and its customers.

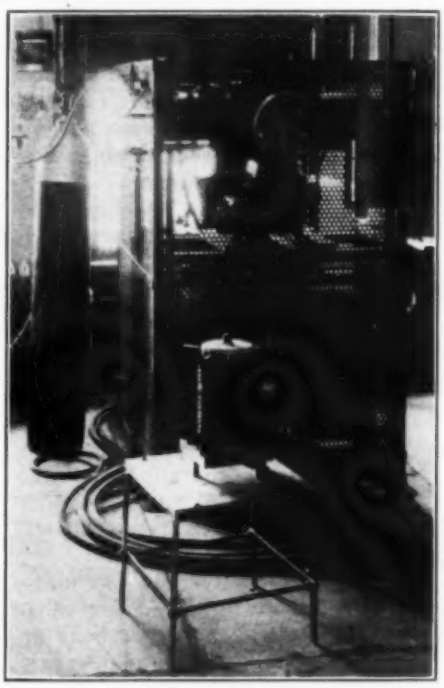
Primarily the department was established to investigate the properties of the various grades of sand offered for sale by the corporation, but the scope has been extended to include a thorough and minute examination of samples of sand sent in from the outside.

Tests Cover Wide Range

Extent to which investigation of sand properties will be carried on in the new laboratory may be inferred to some degree from the list of uses for silica sand. It is used for sand blasting, filtering, furnace bottoms, steel molding, cores for all classes of castings, runners for blast furnaces, ladle patching, slag pockets, brick setting, plastering, mason work, traction, in the preparation of paint and putty, sealing refractory furnaces, ganister for cupola lining and bottoms for malleable iron furnaces.

Sets of specifications have been set up in practically all these fields and unfortunately up to the present, no unanimity of opinion on what should constitute an ideal set of specifications, has appeared. Producers and consumers alike are seeking a simpler and more rational method of evaluating sand. The program of research recently inaugurated by the Industrial Silica Corp., promises gratifying results along this line.

Equipment installed for carrying on the work includes two high frequency furnaces made by the Ajax Electro-Thermic Corp., Trenton, N. J. These furnaces are designed to melt small quantities of metal for use in determining certain properties of sand. It is claimed that temperatures in excess of 3500 degrees Fahr., can be attained in these furnaces. W. S. Tyler Co., Cleveland, supplied the sample splitter and the various pieces of apparatus for making the screen tests. Machines for ramming the sand samples, testing the strength and permeability according to American Foundrymen's association standards, were supplied by the Federal Foundry Supply Co., Cleveland. A laboratory size model of its large mulling machine was made by the National Engineering Co., Chicago. Other pieces of mechanical equipment include an electrically heated oven, a small muffle furnace, a ball mill, an agitator and a laboratory grinder.



THE HIGH FREQUENCY FURNACE IS SERVED BY A TRANSFORMER STATION IN THE SAME ROOM

Roughly speaking, all silica sand suitable for steel foundry practice will show a silica content of 98 per cent or more. In that respect most sands are alike. Apparently the variation in composition in the remaining 2 per cent is responsible for the variations in performance between sands from various sections of the country. Sometimes a difference is found between samples taken from the same deposit. The purpose of the new laboratory is to investigate thoroughly this mysterious 2 per cent, and to determine on some rational method of co-ordinating the results of chemical and physical tests and translating this method into shop language.

Harry H. Smith is research engineer and E. F. Adriance is assistant.

Pittsburgh Foundrymen Nominate Officers

W. E. Troutman, vice president and general manager, Duquesne Steel Foundry Co., Coraopolis, Pa., was nominated for the presidency of the Pittsburgh Foundrymen's association for the fiscal year starting June 1, at the monthly meeting of the organization held April 21. H. F. Seifert, Westinghouse Electric & Mfg. Co., East Pittsburgh, has been nominated for vice president and William J. Brant has been nominated to continue as secretary-treasurer. Members nominated for the executive committee are L. W. Mesta, Mesta Machine Co., Pittsburgh; F. C. T. Daniels, Mackintosh-Hemphill Co., Pittsburgh; W. J. Corbett, Fort Pitt Steel Casting Co., McKeesport, Pa.; H. P. Spilker, Sterrett-Thomas Foundry Co., Pittsburgh, and T. A. Reynolds, McConway-Torley Co., Pittsburgh.

Charles E. Mitchell, associate manager of the Gray Iron institute, Terminal Tower building, Cleveland, spoke on "Foundry Costs" at the meeting. Mr. Mitchell outlined a program of cost computations for average foundries and urged the adoption of a system of cost records to obtain a more accurate method of setting prices.

Bill Gets a Hot Tip on Keel Molding

By Pat Dwyer

OCCASIONALLY—a term sufficiently specific for all present purposes—occasionally during the day I raise the old tired eyes from this insatiable machine which demands copy and then more copy. I raise the old eyes, and throw them over the waters of Lake Erie by way of giving them a rest. Sounds rather paradoxical, but you know what I mean.

If I were to give you the height of my window above the lake level, the distance between the building and the shore line, you could get out the old slide rule, Mr. Bowditch's famous treatise on navigation, a table of logarithms, the rule for computing the areas of circles on a curved surface and thus equipped you could figure to a nicety the area of Lake Erie within my vision.

Some people have a passion for that kind of thing. Juggling figures and covering sheets of paper with long and intricate calculations gives them more pleasure than other men get out of thumbing through a dictionary, hunting shy and elusive words to fill the squares in a cross word puzzle. The net result in each case is the same. As Bill remarked sapiently on one occasion: "After you're through, what have you got? Nothing!"

However, far be it from me to disappoint any would be figurer. If any reader of this great family journal wants to decide for himself, or herself, the area of Lake Erie visible from this lofty perch, I shall be happy to furnish the necessary data on which to base his or her calculation. Send a self addressed, stamped envelope. Write plainly on one side only of the paper and enclose certified check, post office money order, new treasury notes or silver certificates. Silver or stamps positively will not be accepted. Silver dollars impose too great a burden on the pocket. I already have a two-bit book of stamps, sufficient to see me through the summer. Also, stamps invariably arrive at their destination in a gummed up condition. By the time a fellow has them pried apart all the googum has disappeared and they are practically useless, except possibly from a collector's viewpoint, or to one of these eccentric individuals who paper their rooms with them. As a contribution to the list of snappy similes for 1930 I would suggest: As useless as a postage stamp without stickum. This of course may be varied to meet local requirements, as for example, stickum in the north and east, googum in the south and squagum in states west of the Mississippi.

Up to the present I have made no attempt to estimate the area of Lake Erie which I can see while reposing gracefully in a swivel chair. The knowledge would add nothing to the pleasure I derive from throwing an eye over it occasionally. There is something particularly soothing in watching a broad expanse of placid water stretching away to the horizon's rim, with the sun sparkling and with long plumes of black smoke marking the passage of big freighters silently passing east and west.

Distances on water are peculiarly deceptive. Boats with an accredited speed of 10 or 12 miles per hour appear to crawl along at a snail's pace. Occasionally a jet of steam appears in the black plume, but it has dissolved in thin air before the faint blast of the whistle reaches the ear. It is hard to realize that this gentle boom, is the same roaring siren that causes the steel deck plates to vibrate under your feet, that fills your ears with thunder, that affects your entire body like a galvanic battery when you are aboard one of the big brutes, that sail the lakes.

The lake is particularly attractive on stormy days when the vast waste of waters comes rolling in from the horizon and hurls itself unceasingly against the breakwater. Hour after hour great white horses storm the rampart. They rear up against and over it in smashing sheets of spray.

When and if some clever lad discovers a method of harnessing this gigantic source of energy, now going to waste, he will have the world by the tail on a down hill pull.

I was revolving this attractive idea in my mind the other day, for perhaps the 999th or maybe the 1000th time—a fellow loses track of these things—when Bill oozed into the sanctum and asked me what I was dreaming about. I was so startled by his sudden appearance, so far from his usual haunts, that for the moment I was on the point of telling him of my speculation on the subject of harnessing the heaving waters. With rare presence of mind I checked this natural impulse and thus, I am sure, saved myself from a long lecture on the subject of useless people who contribute nothing to the world's work. I adopted the well known military principle of carrying the war into the enemy's country, and thus placed him on the defensive. "Bill, my lad," I said, with hearty

HOTEL LOBBIES ARE FILLED WITH CURIOUS OBJECTS

hospitality, "sit down and take the weight off your long crooked hoofs. To what fortuitous circumstance am I indebted for the pleasure of this visit? What are you doing down in this part of the town upon a perfectly good working day? Are you coming or going? How long do you plan to stay and where do you go from here?"

Bill seated himself comfortably, stretched his long legs to expose a pair of poisonous green socks and then calmly lighted a long black stogie.

"Is there anything else on your mind?" He inquired, casually.

"Well," I admitted, "I kind of figured that list would hold you for a while, but since you press me, I should like to know how you succeeded in passing the argus eyed young lady who sits at the information desk out in the lobby and who puts all visitors through the third degree before she announces their presence to the man they want to see." "Did you ever hear of the cat that died in great agony from an over dose of curiosity?" Bill remarked, "'Tis a dreadful affliction. Here I drop in for a little friendly visit and instead of giving three of those rousing cheers, you bombard me with a string of silly questions as long as the tail of an alderman's coat—and just about as useless. Then to cap it all you as much as intimate that I clandestinely crept down the chimney like Santa Claus. Is that the proper spirit, I ask you, to treat an honored guest when he drops into your den to pay a friendly call?"

Apparently Bill also was familiar with military tactics. If I allowed him to get away with that move, he had me in a corner.

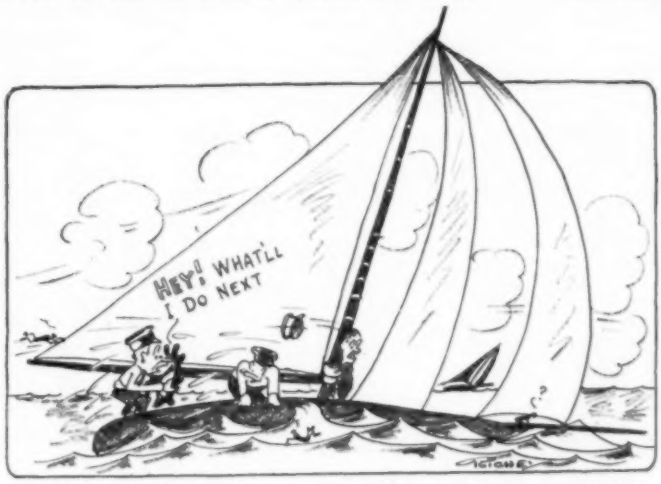
"You heard me the first time," I said. "You are not blind or afflicted with ringworm or botts. Come across with the information. My time is valuable."

"Do you know," Bill said, "I kind of gathered that impression when I came in and saw you gawking out the window and looking like the last rose of summer floating down the river on a grindstone. Since your time is so valuable I will not waste it by attempting to answer all your questions in full. On mature consideration, I don't think I shall answer any of 'em, with the possible exception of the last.

"The bold front, my boy, the easy confident bearing, is the magic key that opens all doors. The clothes—perhaps you have noted the ensemble?—is a valuable contributory factor. The old tippy-toe stuff, bated breath and hat in hand, Horatio Alger technique does not get you anywhere with the modern young guardian of the portals.

"The general idea is illustrated by one of the war time stories. At a public gathering in London, attended by a considerable number of young English and American naval officers, one venerable old gent remarked complacently that one always could distinguish the English officers by their easy and confident bearing.

"'By Jove, y'know,' he said, 'they act as if they owned the place!'



ADVANCE SHOWING OF NEW FASHION IN SAIL ENSEMBLE

"'Quite so,' said the other. 'Quite so.'

"So far as he was concerned the incident was closed, finished and the empire was established more firmly than ever on its foundations.

"Greatly encouraged by the whole hearted and enthusiastic support of his colleague, the first old gent was moved to a further burst of eloquence.

"'These Americans,' he said, 'act as if they do not give a—er—ah—what I mean is they act as if they do not care who owns it! My word!'

"Do you get the idea now?" Bill continued, "or will I have to draw you a map? When I got off the elevator I greeted the young lady cordially. She is remarkably easy on the eyes and showed no displeasure when I commented genially on the elegant taste she displayed in the color scheme of necklace and other accessories.

"However, what's the use of detailing the method to you? You could not apply it. When you show up in front of the information desk the girl does not know whether you are as dumb as you look, or, if you look as dumb as you are. Naturally you receive scant attention. Believe me kid, when I appear, she is not left in doubt. She naturally and intelligently comes to the conclusion that I am the white-headed boy."

"Your clear and convincing explanation," I said, "is lacking in only one item. Trifling, it is true, but still sufficient to leave just a trace of a doubt in my mind."

"Yeah?" Bill inquired suspiciously, "What did I miss?"

"Why," I remarked innocently, "You omitted to mention, that when you appeared in all your glory the girl waved her handkerchief and commenced to sing 'Strike up the band, here comes a sailor!'"

"No," said Bill, "She did not wave her handkerchief and sing strike up the band, here comes a sailor. My reception was cordial, but I would not dream of exaggerating the account by dragging in an inconsequential detail of that kind. However," he added with a grin, "although she did not say so, I bet before I left she was saying to herself, 'The marines have landed and have the situation well in hand!' That reminds me, talking about sailors and marines and one thing and another, that Sir Thomas Lipton is bringing his fifth Shamrock across this summer to attempt to lift the famous cup and take it back to England. There's a real sporty old lad, if ever there was one. Undismayed by four former trials he is going to try again. From a purely patriotic standpoint I should like to see the cup remain on this side, but if any foreign boat lifts it, I hope it will be one owned by this gallant old sportsman.

"I suppose it is all in the rules of the game, but it seems to me that the challenger is unduly handicapped in that it has to be built substantially to sail across the Atlantic to take part in the race. The defender is not subjected to any test of that kind. It needs only to be capable of scooting over a 15-mile course in comparatively mild weather. In the 1920 series the second day's race was called off because forsooth the wind was blowing at an 18-knot clip."

"You seem to forget," I pointed out, "that this international racing series was started when the AMERICA sailed across from this side to take part in a yacht race off the Isle of Wight in 1851. She lifted the cup at that time, sailed home with it and it has remained here ever since."

"That was a different proposition altogether," Bill explained. "The

AMERICA was a big topsail schooner, capable of sailing around the world and was not much like one of the yachts built under present racing rules.

"Consider the present SHAMROCK V, 120 feet overall, 20 foot beam, carrying a sail spread of 7500 square feet with the peak of the main sail 152 feet above the deck. How would you like to hang on with teeth and claws to the weather rail of that baby while she drove along at a racing clip, lee rail submerged under 3 feet of hissing green water? With the standing rigging humming like the strings of a harp under the tremendous strain? With the great sail sheeted down close, as stiff as a steel plate and the main sheet as rigid as a rod of iron? How would you like that? Hey? Yacht racing is essentially a masculine sport, one designed for stout hearts and stout hands. The deep elemental, primal pleasure found by healthy men in violent physical exercise, in a highly keyed mental state and in the suspense incident to the contest, furnish a sustained mental and physical thrill experienced in no other form of locomotion ever devised by man. Horses, automobiles, power boats, airplanes, they all furnish thrills, but for the real simon pure quill, let me grab the wheel of a racing yacht while she is flying like a bat out of—well, while she is tearing off the long sea miles like an old time clipper racing home through the roaring forties."

"You can have my place," I said. "I would not sail on one of those things on a bet. When I see them leaning over I am always afraid they are going to turn turtle."

"Not a chance," said Bill. "You can't tip 'em over any more than you can upset one of these long Johnny-jump-up contrivances that have taken the place of cuspidors in all the hotel lobbies. The boat itself sits lightly, but with a big lead keel projecting from the bottom she draws almost as much water as a battle ship."

"That should be a good job for a foundry," I said, "lots of weight and not much work in making the mold."

"Well," said Bill, "I'll tell you. It is and it isn't. The weight is there alright, but unless you know your onions, you will run into grief with the long, small diameter holes for the bolts by which the keel is fastened to the bottom of the boat. If the casting is poured on the side, the cores will spring in the center and, irrespective of whether it is poured horizontally or vertically, the terrific heat and pressure of the metal will reduce the core to a solid mass almost impossible to clean out. The best method is to employ lengths of heavy steel pipe filled with silica sand, powdered silica or plumbago with a generous size vent hole in the center and thoroughly dried.

"In recent years these castings no longer are made in the foundry. Lead keels now are poured in wooden molds set up in the yard in close proximity to the boats for which they are intended. They are poured right there."

SELDOM, DEAR FRIENDS, ARE OUR BEST AND MOST EARNEST EFFORTS APPRECIATED

"Wooden molds?" I exclaimed in astonishment. "Won't they burn?"

"Believe it or not," Bill replied, "there it is. The old foundry business is not what she used to be. What I am wondering now is how do the American Federation of Labor and the census enumerators classify the lads who make these castings. Are they carpenters or molders?"

"Foundry conditions are changing," I said. "Any one can be a molder now."

"Ain't it the truth?" Bill deplored. "The gall of some of these lads is beyond belief. They visit a foundry for an hour or two and then imagine they know all about it. Every once in a while the employment clerk hires one and sends him in to me. One of these breezy, hustling lads appeared the other morning and I gave him a pattern and showed him a place in the floor where he might bed it in. He seized a shovel and commenced digging a hole as if he had been digging it for years.

"A couple of hours later he came into the office with the honest sweat dripping from his forehead and with the eager look of one who expects to hear: 'Well done, thou good and faithful servant' or the modern equivalent 'Attaboy, I wish I had a dozen more like you.'

"He was all set for a pat on the back."

"'Say, Boss,' says he with just the proper mixture of pride and modesty, 'I have buried that son-of-a-gun. What'll I fly at next!'

"You can fly for your coat, my lad," I says to him, "and fly out of here or there will be another burying party, and another son-of-a-gun retired from circulation!"

"What about these wooden molds?" I persisted. "How do they make them and how are they poured and why do they not burn?" "Why," Bill replied, "they build them in the same manner that a carpenter builds a form in which concrete is to be poured. Of course they are built more substantially on account of the greater weight they must support, but the general procedure is the same. Frames are set up conforming to the contour of the casting and then the inside is sheathed with narrow strips easily bent to shape. A light coating of liquid plaster is applied and in some instances the plaster is covered with graphite paint. That kind of a mold would not serve for an iron casting, but it serves admirably for one made of lead. Where the mold is made in the open, it is strongly braced to resist the lateral pressure. Occasionally, one of these castings is made in a foundry where it is placed in a pit in the floor and sand is rammed around it after the manner of enclosing a loam mold.

"Round wood plugs are erected and braced at the necessary points to form the bolt holes and a flat wood slab is erected in the center, if the keel is for a center board boat. These pieces of wood are removed easily after the casting has cooled."

L. Best Co., Inc., 28 West Broadway, New York, has been appointed export representative of the Cleveland Quarries Co., Cleveland. The Best company also will act as distributors for loose and mounted grinding stones in the Metropolitan district. That company already is distributor for grinding wheels made by the Sterling Grinding Wheel Co., Tiffin, O., a subsidiary of the Cleveland Quarries Co.

WHAT OTHERS ARE THINKING

Abstracts Selected from the World's Foundry Literature

Explains Centrifugal Casting

Notes on the Centrifugal Casting Process, by J. E. Hurst, *Metallurgia*, Manchester, England, January and February, 1930.

Although the centrifugal casting process has been in use for many years, it only is recently that the process has been placed on a commercial basis extensively. In this article, the author outlines the history of the process and describes some of the early patents.

He then discusses where the centrifugal casting method is used and names several types of castings that are manufactured in that manner. He explains the factors that should govern the selection of the axis of rotation and shows diagrammatically several pouring methods. He also describes several centrifugal casting devices.

The second part of the article deals with defects in castings produced by the centrifugal method. These defects take the form of surface laps, surface splashes, surface depressions, pinholes, spongy patches on the inside surface of the casting and roughening of the inside surface. He discusses each of these defects in detail and explains their cause and method of elimination.

Gives Alloy Steel Data

Legierter Stahlguss in Theorie und Praxis (Alloyed Steel Castings in Theory and Practice), by Albert Rys, *Stahl und Eisen*, Duesseldorf, Germany, April 3, 1930.

In this article the author discusses the adaptation of the steel through alloying for special mechanical, physical and chemical demands. He also presents data on investigations of the strength properties of various alloy steel castings including the effect of high temperature, the possibility of their improvement and the most appropriate heat treatments. The author also discusses high and low alloy types of steel castings for such services as wear resistance, resistance against corrosion and chemical attack, impact and compression, and high strength under high temperature. Data also is given on nonmagnetic, stainless, acid-resistant, and heat resistant steels.

Internal Tension Causes Breakage

Casse au Feu des Pieces en Fonte Destinees a l'Emaillage (Breaking in the Furnace of Castings That Are Being Prepared for Enameling), by Stephane de Nagourski. *La Revue de Fonderie Moderne*, Paris, Jan. 25, 1930.

In this short article the author emphasizes the fact that much breakage occurs when castings are being heated previous to enameling operations. These breakages are caused in many cases by internal tensions, which themselves are due to the shape of the castings. One of the contributing factors to breakage is the fact that the designer often does not realize the effects of the heating operation when planning the casting.

An illustration shows an example of a casting which presents a number of angles and varying thicknesses. It is explained how such a casting, when heated, expands more rapidly in certain parts than in others, with the result that breakage occurs in the least resisting section. One remedy is indicated. That consists in placing the casting so the part offering the least resistance is presented to the hottest part of the oven. However, the real remedy consists in modifying the design of the casting, and the illustration shows how a slight modification in the section can prevent a breakage from occurring, while preserving the general shape of the casting. Similar remarks apply to castings which have to be straightened before enameling, because of deformation during the heating process.

Determines Cupola Dimensions

Die Hauptabmessungen von Giessereischachtoefen Kupoloefen) (The Principal Dimensions of Foundry Cupolas), by Bernhard Osann, *Die Giesserei*, Duesseldorf, Germany, March 28, 1930.

To obtain the best efficiency of coke consumption and the best results in melting in the cupola, it is essential that the dimensions of the cupola are correct. Therefore, the author presents data on determining the principal dimensions that affect the previously mentioned factors. These are the cross sectional area and the height of the cupola. Osann states that the cross sectional area should not be under 1200 square centimeters (472.4 square inches) per ton of molten metal per hour. He then gives several methods of determining the height. One is based on the speed of the gases through the cupola, the second is based on the period of working the charges and the third on the wind pressure.

Surveys High Duty Cast Irons

Les Fontes a Resistance Elevee (High-Duty Cast Irons), by A. Le Thomas. *Bulletin*, Association Technique de Fonderie de Belgique, Brussels, March, 1930.

This article is the reprint of a paper presented by M. Le Thomas before the Liege section of the Belgian foundry association. The author is a specialist in the study of high-duty cast iron, and has spent considerable time and experience in methods of testing. The article embodies a comprehensive survey of high-duty cast irons in connection with their characteristics.

In the introduction, the author shows the practical interest of recent progress in obtaining cast iron of high tensile strength. He then reviews the various characteristics that are required of cast iron in modern engineering practice. Two defects are brought to the reader's attention, one being the lack of continuity of the metal, the effects of which are porosity, segregation, gas inclusions, etc., and the other defect being mainly internal stresses. The author also reviews the characteristics of tensile strength and facilities of machining under the headings of chemical composition, texture, cooling and heredity. The resistance to high temperatures and corrosion also are described. In the third part of the article the recent improvements in modern methods of production are reviewed. The article ends with a brief survey of modern methods of investigation.

Discusses Pearlitic Cast Irons

Notes Upon the Manufacture and Value of Pearlitic Cast Irons, by Horace J. Young, *The Iron and Steel Industry*, London, March, 1930.

Many articles have been written extolling the value of pearlitic irons which have been produced by processes invented during the past few years. In this article the author warns about misconstruing the value of pearlitic irons. He says that it is difficult, if not impossible, to determine whether an iron is or is not wholly pearlitic. He explains the structure of pearlite and gives several variables that influence it.

Since the determinations of total and graphitic carbon are subject to inaccuracies, it is difficult to ascertain whether a structure is entirely pearlitic. The microscope also is inaccurate, because only an extremely small area is observed at one setting of the instrument. He gives several factors that the service properties of a pearlitic iron depend upon, namely: Size of the pearlite lamellae; size, shape, distribution and quantity of graphite voids; grain size; and the manner in which the previously mentioned effects have been obtained.

The author points out the fallacy of the statement that strength varies with the percentage of combined carbon which is lowered in the proportion that it is cut up by graphite flakes. This statement has been made where semi-steel mixes have been used. He further states that irons of low carbon content often are exceeded in strength by those of higher carbon content. In the latter part of his article the author deals with the properties of cylinder irons and predicts the properties of the irons that will be used in the future for the production of cylinders.

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¶ Should Broaden Vision

WHILE the community leadership in solving social and economic problems of modern society largely has been left to the Rotarians, Lions, Kiwanis, etc., this condition will not exist much longer according to a prediction of Carl E. Grunsky, president, American Engineering council. He criticizes the engineer for his traditional isolation from other groups, but asserts that following the example of Mr. Hoover and other engineers who have won high public posts, this attitude is changing. As Mr. Grunsky mentions, the modern tendency in practically all professions is to specialize and this in turn leads to an inherent desire for intimate contact and close association with those who are engaged in the same activities.

THIS tendency is not without its good points as it leads to progress and advance in the specialized lines, but unless strenuous efforts are exerted, the broader aspects of the professions are narrowed down considerably or lost sight of altogether. While Mr. Grunsky is concerned particularly with engineers, it should be pointed out that the remarks apply equally well to foundrymen. By coming out of their shells and becoming active in public affairs, they can render useful services to their immediate communities and to the country at large. Foundrymen should keep in touch with local and national affairs, and discuss them with their associates. Further, they should cultivate any engineering or purchasing groups. Those men specify or buy castings.

¶ Six Men and One

SEVEN men were in the Pullman smoking room at the start of an overnight trip. Three salesmen compared notes, agreeing on the generally bad conditions that they were encountering in their various lines. A farm owner returning to his home in one of the central western states contributed the opinion that none of the others could appreciate hard times. "The farmers are ruined," was the substance of his remarks. A manufacturer of women's apparel and a grocery wholesaler added to the chorus with a plaint against changing, fickle styles and the encroachment of chain stores. The silent seventh man listened. He made no addition to the moaning chorus. In fact the jobbing foundry business might not be so bad. He, at least, was not subject to the whims of the weather, the board of trade, women's styles or the pressure of well-organized, highly capitalized, centralized-group competition at his door.

¶ Why Beat the Drums Slowly?

IMAGINE all of the casting manufacture of the country concentrated in twenty or thirty foundries instead of the several thousand now in existence. Picture the production of pig iron and coke distributed over six or seven thousand unrelated blast furnaces and coke plants. Then, just fancy contracting with some of the multitude of raw materials producers on this basis. Say, for example, castings were selling for 10 cents a pound. As one of the big castings manufacturers you might find it desirable to cut the price to 9 cents, a ten per cent drop. Can't you just hear the yell that would go up from the pig iron and coke interests if you would suggest to them cutting *their* prices a similar amount?

AUTOMOTIVE interests have passed the low point in their production. Practically all of them have cleaned up their dealers' back stock and used car surplus figures are lower than for several months past. Yet, some of them, large buyers of castings, are sounding out their foundry sources, using a plea of poor business to elicit reductions in prices. Some have stated that they may be forced to cut the prices of their automobiles and that, therefore, they should have a lower price even on existing castings contracts. Many foundries making automotive work have practically gone the limit in cutting corners to reduce costs. Obviously, only a small saving can be expected even with receding metal prices, for the major part of the cost of any automotive casting is in labor or in the overhead incidental to extensive labor saving machinery. In pressing the demand for lower prices, the automotive interests are running counter to their own announced principle of adequate wages to support the public buying power as relates to automobiles. Normally the most optimistic of the major industries, the automobile manufacturers, should be the last to sound the retreat, and to bring prices below costs, at the expense of wages.

Personal

RUSSELL F. HAMILTON, for the past five years, research engineer and assistant foundry foreman, Michigan Steel Casting Co., Detroit, has become associated with the Jones & Laughlin Steel Co., Pittsburgh, shops and foundry division, as time study man. Mr. Hamilton was graduated from Ohio State university in 1920 with a degree in chemical engineering. After graduation, he accepted a position with the Jones & Laughlin Steel Co. where he spent 4 years in the industrial engineering department and in rolling mill operation.

Arthur J. Busch, formerly connected with the King Mfg. Corp., Buffalo, has resigned that position of become manager of the E. R. Caldwell Co., Bradford, Pa.

D. A. Currie vice president and general manager of Erie Foundry Co., Erie, Pa., has been elected vice president of the Erie Manufacturers association.

D. W. Ardiana, for the past several years, production manager, Los Angeles plant of Kay-Brunner Steel Products, Inc., has been appointed general manager of that company's plant at Alhambra, Calif.

R. M. Hayes, formerly superintendent of the Hanford Iron Works, San Bernardino, Calif., has resigned his position to devote himself to his personal interests.

Establishes Loan Fund

Daniel C. Jackling, San Francisco, president, Utah Copper Co., Salt Lake City, Utah has established the Jackling foundation at the Missouri school of mines and metallurgy, Rolla, Mo., for education in the sciences and arts pertaining to the mineral industry. The purpose of the foundation is to aid worthy students in securing an education by loan funds and to provide scholarships and special educational features. The fund eventually may total $660,000, of which $100,000 will be available as loan funds and the remainder for scholarship and special educational purposes. The fund is for the use of not only of American students but for foreign students who wish to study in the United States. American students wishing to study advanced subjects in foreign universities also may receive scholarships from the fund. A part of the fund will be used for the appointment of faculty members and lecturers in special fields of metallurgy. Mr. Jackling is a graduate of the Missouri school of mines and metallurgy in the class of 1892.

Publication Describes Indiana Sands

An analysis of the properties and distribution of the foundry sands in Indiana has been published in a 12-page pamphlet by the Indiana State department of conservation. A geological map of the state is included as well as a map showing specific locations of sand deposits. The various grades of sand found with a brief analysis of each is listed by counties in the state. The publication may be obtained free from the Department of Conservation, State House, Indianapolis.

Changes Meeting Date

The next meeting of the New England Foundrymen's association will be held in Worcester, Mass., May 21. The meeting is being held on the third Wednesday of the month rather than the second which is the regularly scheduled date. The name of the speaker and other information will be mailed to members soon.

Gives Equipment Orders

The index of gross order for foundry equipment in March was 164.1 as compared with 196.4 in February, according to a recent report of the Foundry Equipment Manufacturers' association. The index of shipments for March was 194.5 compared with 169.6 for February. Unfilled orders for March were 411.1 against 424.7 for February. The base is the average monthly shipments for the years 1922-23-24. Comparison by monthly orders as presented by the Foundry Equipment Manufacturers' association follow:

Month	1927	1928	1929	1930
Jan.	180.4	132.7	180.5	160.1
Feb.	198.0	123.6	197.0	196.4
March	131.1	138.6	209.4	164.1
April	130.0	107.7	172.6	.....
May	134.8	335.6	177.7	.....
June	138.4	149.1	177.3	.....
July	89.9	94.8	219.3	.....
Aug.	106.4	278.0	229.5	.....
Sept.	80.4	170.0	216.3	.....
Oct.	98.0	185.0	245.3	.....
Nov.	95.8	197.8	178.6	.....
Dec.	106.8	166.5	208.0	.....

Lists Accomplishments

The 1930 *Standards Yearbook* recently has been published by the department of commerce. The present volume contains outlines of the activities and accomplishments of not only the national bureau of standards and other agencies of the government, but also those of technical societies and trade associations. Special emphasis is placed on accomplishments during the year 1929, and on programs of future work and the methods employed to facilitate the use of standards and specifications. An outline of the significant standardization activities in transportation, an article covering the developments in calendar simplification, and a bibliography of recent publications relating to standardization are special features of the book.

Frederic B. Stevens Issues a New Book

"Treasure Trove," the tenth of a series of unusual and interesting personal observations of Frederic B. Stevens, Detroit, under the classification the "T" series, has just been published. In this Mr. Stevens gives some interesting sidelights on a recent trip to Europe, thumbnail sketches of his friends, Merrill Z. Fox, John A. Penton and Palmer H. Langdon and an unsual array of collection letters that bring the cash and leave no remorse behind. Mr. Stevens embodies in these occasional publications a reflection of his kindly philosophy and capacity for friendship. Information on the commercial products that Frederic B. Stevens, Inc. manufactures and which are of interest to the foundry trade is merely incidental.

Moves Sales Offices

Connersville Blower Co. Inc., Connersville, Ind., has moved its Chicago sales office to room 1428, at 20 North Wacker drive. The New York sales office of the company, after May 1, will be located at room 533, Graybar building, 520 Lexington avenue.

Publishes Booklist

At the instigation of the New Jersey chapter of the American Society for Steel Treating, the Newark, N. J. public library has published a list of books and periodicals of interest to the metal trades. The list is classified according to the various divisions of the industry and works of special importance are noted. In the introduction to the list the librarian offers the library's special technical services to all New Jersey residents engaged in the industry, and invites the use of the inter-library loan service for books not found in local libraries. Copies of the booklist may be had at 15 cents each on request to the Newark public library, Newark, N. J.

Obituary

James William Beaman, for the past 27 years malleable iron foundry superintendent, William E. Pratt Mfg. Co., Chicago, died April 10. Mr. Beaman was born in England, Oct. 7, 1850 and came to the United States when he was 2 years old. His boyhood was spent in the New England states. In 1890 he entered the employ of E. Y. Moore, manufacturer of malleable iron products, and was employed at the Milwaukee plant of that company for 10 years. Later he was transferred to Cleveland and placed a new plant in operation for the Chisholm-Moore Co., of that city. He left the employ of that company in 1902 and went to Joliet, Ill., to help establish the plant and foundry of the William E. Pratt Mfg. Co. He retired about a year ago but since that time had acted in an advisory capacity.

A. C. Weber Jr., assistant secretary and treasurer of Pontiac Pattern & Engineering Co., Pontiac, Mich., died recently following an operation.

Frederick H. Deacon, for many years secretary and treasurer of the Cresson-Morris Co., Philadelphia, died April 7, at his home in Philadelphia. He was 76 years old.

Thomas L. Andrews, formerly connected with the Marshall Foundry Co., Pittsburgh; vice president of the Bollinger-Andrews Construction Co. and organizer of the Andrews Engineering Co., died at the Pittsburgh hospital recently. Mr. Andrews was born in Chester, Pa., and was 63 years of age.

John E. Sweet, secretary and purchasing agent of Farrell-Cheek Steel Foundry Co., Sandusky, O., died recently in St. Petersburg, Fla. Mr. Sweet had been identified with the Farrell-Cheek company since its formation in 1910. He retired from active service about three years ago.

Francis Downs Wanning, 57 years old, vice president, Farrel-Birmingham Co. Inc., Ansonia, Conn., died at New Haven hospital, recently after a protracted illness. He had been actively and continuously identified with the company and its predecessor the Birmingham Iron Foundry, for 35 years.

William W. Emmett, for many years connected with the foundry department of Emmett & Podas, Los Angeles, died recently after several weeks illness. Mr. Emmett migrated from Colorado over 20 years ago and was employed in a number of the larger foundries in the Los Angeles district. In 1919 he became engaged in business with the firm of Emmett & Podas.

Robert Hutchins McNall, 64 years old, who retired a year ago as president of the Gilbert & Barker Mfg. Co., Springfield, Mass., maker of gasoline pumps and filling station equipment, died at his home in New York recently following a brief illness. For more than 40 years Mr. McNall was connected with Standard Oil Co. interests. He became president of the Gilbert & Barker Mfg. Co., subsidiary of the Standard Oil Co. of New Jersey, in 1912, and was actively connected with the business until his retirement.

Brainard F. Phillipson, 40, president of Climax Molybdenum Co., New York, since it was organized in 1919, died April 7. After graduating from Columbia university in 1913 with a degree in chemical engineering he became identified with American Metal Co. Ltd., New York, where he remained in various capacities until 1919, when its associate, Climax Molybdenum Co. was formed. Mr. Phillipson devoted much attention to the development of molybdenum and its applications, particularly when cessation of the war ended its use as a munition material. He was a member of American Society for Steel Treating, American Society of Automotive Engineers, American Iron and Steel institute and several other industrial organizations.

National Metal Trades Association Meets

Approximately 250 members attended the thirty-second annual meeting of the National Metal Trades association held April 16-17 at the Hotel Astor, New York. Several excellent papers were presented, the burden of the discussions touching on industrial education and personnel relations.

George E. Roberts, vice president of the National City bank, New York, discussed business conditions asserting that the clue to prosperity lies in equilibrium of economic life. That the automotive industry is now on the mend, was the opinion expressed by Alfred Reeves, general manager of the National Automobile chamber of commerce, in an address before the association. E. K. Hall, vice president of the American Telephone & Telegraph Co., presented his views on the essentials in personnel policies. A paper on industrial education was presented by H. S. Falk, Falk Corp., Milwaukee. The paper covered a plan for training an apprentice in the machine trade. Methods of meeting the problem of seasonal unemployment were discussed in a paper written by S. A. Lewisohn, vice president, Miami Copper Co., New York.

Floyd Gibbons, war correspondent, was principal speaker at the annual dinner, and Commander Edward Ellsberg, U. S. N. R., was the speaker at the general luncheon. Commander Ellsberg described difficulties in raising the submarine S-51.

J. G. Benedict, general manager, Landis Tool Co., Waynesboro, Pa., was elected president to succeed Harold C. Smith, Illinois Tool Works, Chicago, Ill.; Jacob B. Cox Jr., president of the Cleveland Twist Drill Co., Cleveland, was appointed first vice president; H. C. Beaver, vice president and treasurer of Rolls Royce of America Inc., Springfield, Mass., was appointed second vice president; and J. W. O'Leary, of Arthur J. O'Leary & Son Co., Chicago, was re-elected treasurer.

Newly elected councillors are: F. J. Shepard Jr., treasurer, Lewis-Shepard Co., Boston; H. F. Wahr, president, Mesta Machine Co., Pittsburgh; Angus S. Macdonald, president, Snead & Co., Jersey City, N. J.; E. C. Bayerlein, vice president and treasurer, Nordberg Mfg. Co., Milwaukee; C. R. Gardinor, president, International Silver Co., Meriden, Conn.; and Harold C. Smith, Chicago.

Business conditions were described as being fair to good. Of 600 member companies reported, 77 per cent described business in this manner and 33 per cent as actually being as good or better than last year. Eighty-three per cent reported the business outlook as fair to good.

Has Article in Harpers

While machinery plays an important part in every industrial activity, the successful operation of the foundry depends upon the skill of the workman. C. J. Freund has pointed out this fact in an exceptionally interesting fashion in an article appearing in the April number of *Harper's* under the title "Molten Steel, The Making of a Foundryman." The article narrates the impressions of a young college graduate as he takes his place for the first time with the night pouring crew in a large steel foundry. His first duty was assisting the chainman as the crane traveled back and forth over the foundry floor. The first night, as this embryonic foundryman saw the heat pourer skillfully signal the craneman as the ladle was spotted over the gate, and then pull the lever that sent the stream of white hot

metal into the mold, he decided that he wanted to be a pourer. Of course, after months of labor he succeeds.

Mr. Freund has struck a decidedly realistic note throughout the entire story, a quality which is lacking in so many stories on industrial life which are published in numerous popular periodicals today. The reader must realize, before he is far along in the story, that the author has an intimate knowledge of the background which is being described. The picturesque and thrilling details of the steel foundry have been developed, with facts rather than fiction as a basis.

During the past few years Mr. Freund has written a number of articles which have appeared in THE FOUNDRY. The most recent of these appeared in the Feb. 15 and the March 1 issue under the heading "Let Apprentices Sell Apprenticeship."

Discuss Foundry Safety

About 200 safety engineers and plant executives interested in industrial safety activity met at the Pittsburgh chamber of commerce auditorium, April 17, for Pittsburgh's seventh annual Safety Engineering conference held under the auspices of the Western Pennsylvania Safety council. Technical sessions were held during the morning and afternoon.

A feature of the afternoon program was a symposium on "Foundry Hazards" consisting of discussions on that subject by representatives from five of the large foundries of the Pittsburgh district. Poor ventilation and improper lighting in foundries was described by Edward J. Kroen, personnel manager, Walworth Co., as the chief cause of fatigue among workers. Improvement in those two items had been followed by a reduction in accidents at plants of the speaker's company. J. C. Campbell, safety director, Union Switch & Signal Co., Swissvale, Pa., listed a number of common foundry hazards including improper piling of flasks, use of wet sand, and carelessness in lifting. Lack of sufficient pit room and failure to provide holes in charging boxes for drainage of casual water were mentioned by Walter H. White, superintendent, open hearth department, Duquesne Steel Foundry Co., Pittsburgh, as hazards in steel foundries.

Reed Air Filter Co., the Midwest Air Filter Co., and the National Air Filter Co., have been consolidated under the name of the American Air Filter Co. Inc., Louisville, Ky. The latter firm formerly was the holding company for the three concerns.

Elected President

R. W. Gillispie, formerly vice president and general manager, Jeffrey Mfg. Co., Columbus, O., has been elected president and sales manager of that organization. Robert H. Jeffrey, formerly president, has been elected chairman of the board of directors. Mr. Gillispie was born in Oyster Bay on Long Island and attended schools in New York and Brooklyn. He attended Wesleyan university, Middletown, Conn., and was graduated in 1904. He then entered the employ of the Pennsylvania Steel Co., Steelton, Pa., as an apprentice on a blast furnace. He remained

R. W. GILLISPIE

with that company and the Bethlehem Steel Co., by which it was absorbed, for 22 years. During that time he served in various capacities as district manager in New York, assistant and and general sales manager, and as assistant manager of structural and plate sales. He resigned the latter position to become vice president and assistant general manager of the Jeffrey Mfg. Co., in 1926. He was promoted to vice president and general manager in 1927 which position he occupied until his recent appointment.

Executives Are Advanced

W. S. Rugg, vice president in charge of engineering, Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., has been placed in charge of sales in addition to his engineering activities, according to an announcement by F. A. Merrick, president of the company. Mr. Rugg, takes over the activities of Edward D. Kilburn, vice president and general sales manager, who resigned recently to engage in private business. S. M. Kintner, director of the Westinghouse research laboratory, has been made assistant vice president, and assumes engineering department duties under Mr. Rugg's direction.

Foremen To Hold Meeting in Toledo

The seventh annual convention of the National Association of Foremen will be held in Toledo, O., June 6 and 7. Members and guests will register at the Commodore Perry hotel on Friday morning, June 6, and will visit any of a large number of manufacturing plants. Following the plant visitation program a conference will be held on the operation and program of a foremen's club. The plant visitation will be resumed in the afternoon followed by another conference later. The annual dinner and business session will be held in the evening at 8 o'clock at the chamber of commerce.

The Saturday program will consist of registration at the Civic auditorium and addresses by E. W. Knight, president, the Foremen's Club of Toledo; Hon. W. T. Jackson, mayor of Toledo; George Tibbits, president National Association of Foremen and George M. Graham, vice president, Willys-Overland Co., Toledo. The remainder of the morning will be devoted to conferences. The afternoon program will consist of addresses and conferences. A banquet will be held in the evening at the chamber of commerce which will be followed by a boat ride on the steamer, GREYHOUND.

A program also has been arranged for the ladies which will include plant visitations, shopping tours, a motor trip and various other entertainment features.

Engineers Visit Foundry

Members of the Springfield Engineers club, Springfield, O., heard talks by Ralph Burke, works manager, Springfield plant of the Ohio Steel Foundry Co., on "Recent Developments and Applications of Steel Castings" and by Frank Zeigler, manager of the alloy steel casting plant of the same company at Springfield, on "Steel Alloys" recently. Following the regular monthly dinner-meeting members of the club were guests of the speakers on a tour of inspection of the new alloy steel casting foundry.

Chain Belt Co., Milwaukee, has appointed the Corbin Supply Co., Macon, Ga., representatives for the chain and transmission equipment it makes.

Speed Work in New Shop

(*Concluded from Page* 55)

into the molds as they moved along.

Molding unit No. 7, the snap flask unit equipped with a sliding plate conveyor 160 feet long center to center of sprockets, is driven by a 7½-horsepower motor and runs at a speed of 5 to 20 feet per minute. The drive arrangement is similar to the car type conveyor. Cast iron plates 16 x 16 inches, spaced 27 inches on centers slide on a 30-pound rail. A 9-inch pitch, single stand chain running on 60-inch pitch diameter head and foot sprocket, carries the plates.

This conveyor is provided with an automatic shakeout. By a cam and lever arrangement, the trays are tilted to an angle of about 30 degrees to the horizontal, to discharge the sand and castings upon a vibrating screen. The bottom boards, held on the trays by special angle clips, are returned to the molders. The sand goes through the screen on an inclined belt, and returns to the system while the castings fall upon an apron conveyor, and are elevated to a point where they may be trucked to the cleaning room. The sand preparation unit is similar to the unit used on the car type mold conveyor unit.

Has Large Cleaning Room

The cleaning room, 60 x 500 feet, affords ample space for all cleaning operations, storage and shipping of castings. The castings from the molding floors enter the cleaning room at several places, passing through their respective cleaning cycles in a progressive manner.

Large castings are cleaned by water blast or hydraulic core knockout. The equipment consists of a large rotary table in which castings to be cleaned are loaded, a washing chamber through which the castings pass, a motor driven multistage centrifugal pump, capable of developing a pressure of 400 pounds per square inch, and a special blast nozzle which the operator manipulates from the outside of the cleaning chamber.

The casting to be cleaned is chained to a special turntable which the operator can turn at will. The core and other sand is washed into a settling pit from which it is carried to the dump. This method of cleaning leaves the casting smooth and free from sand. A 5-ton crane is used to handle these castings in loading ,and unloading the waterblast table and carrying them to the swing grinders, chippers and tumbling mills.

Medium weight castings are sand blasted, ground and chipper, while the small castings are milled. Another 5-ton crane is used to lift the castings about in trays. The tumbling mills were furnished by the Whiting Corp., Harvey, Ill., and the stationary grinders used for grinding the small castings, by the Bridgeport Safety Emery Wheel Co. Inc., Bridgeport, Conn. The sandblast equipment, the hydraulic washer and the three dust arrestor units, on a mezzanine floor were supplied by the Pangborn Corp., Hagerstown, Md. Dust from the arrestors is discharged into an 8-inch pipe by rotary dust valves and carried to the dump hydraulically.

A service building 216 x 218 feet contains the foundry offices, pattern shop, pattern storage, physical and chemical laboratories, first aid, employes' locker room, shower baths and individual lockers.

Quad-City Group Holds Election of Officers

The annual meeting of the Quad-City Foundrymen's association was held May 5, at the Davenport chamber of commerce. Dr. J. G. Pearce director British Cast Iron Research association, was the speaker of the evening. He addressed the meeting on the accomplishments of the Institute of British Foundrymen in behalf of the industry and explained some recent developments in general foundry practice in Great Britain and referred to cupola practice in particular. Officers and directors also were elected at the meeting. Officers are as follows R. L. Eichman, Bettendorf Co., Bettendorf, Ia., president; E. A. Gullberg, Union Malleable Iron Co., Moline Ill. vice president; Stanley Brah secretary. Directors elected include John H. Ploehn, French & Hecht, Inc., Davenport, Ia.; P. T. Bancroft, John Deere Harvester Works, East Moline Ill.; John H. Dietrich, Blackhawk Foundry & Machine Co., Davenport, Ia.; Hyman Bornstein, Deere & Co., Moline, Ill.; A. D. Matheson, French & Hecht, Inc., Davenport, Ia.; F. W. Kirby, John Deere Spreader Works, East Moline, Ill.; A. E. Hageboeck, Frank Foundries Corp., Moline, Ill., Charles Demmler, Walworth Mfg. Co., and E. W. Rice, John Deere Tractor Co., Waterloo, Ia.

Alda Research Laboratories Inc., 660 South Eighteenth street, St. Louis, has been organized to carry on research in metallurgy, ceramic, electrical and industrial chemical engineering, machine design, physical testing and micrographic, x-ray and radiographic work.

Apply Continuous Process in Malleable Foundry

(*Concluded from Page* 64)

where the pourers stand on a moving platform and pour them off continuously by ladles carried by electric hoists operating on an overhead monorail loop. The pourers' platform moves at the same travel speed as the molds. Fig. 7 shows all of the eight pouring stations on two of the molding units. It also shows the overhead monorail loop on which the ton ladles travel in bringing the hot metal from the electric furnaces.

The molds are cooled on the return path of the mold conveyor, and at the end they are dumped on to a vibrating shakeout screen, shown in Fig. 5. The sand discharges through the screen, while the castings free from sand are discharged into baskets which have perforated plate sides to hasten the cooling of the castings. These baskets are carried by a trolley conveyor to the outside of the building for cooling. Then they go to the cleaning room, where they are dumped. From this point the empty baskets are returned to the various shakeouts for reloading.

Annealing the Castings

The castings are carried from the cleaning department to the annealing room on a belt conveyor. The annealing process has been continuous for years. Three oil-fired kilns of the pusher-car type anneal all the castings. The two larger kilns are each 347 feet long and are regularly operated on a 96-hour annealing cycle, but have produced consistently good iron on a 90-hour cycle, which is equivalent to 65 tons of castings daily from each kiln. The other kiln, 180 feet long, has operated for months on an 80-hour cycle and occasionally on a 72-hour cycle, with excellent results. On the latter schedule about 40 tons of castings can be annealed daily.

The matter of continuous melting, molding, pouring and annealing is of particular interest to the malleable industry of today. Production and cost records prove that the money invested in our continuous process equipment has been justified fully. Further strides along these lines will present themselves as time goes on, and the malleable industry should be ever alert to make use of any equipment which tends to give a better product at a lower cost.

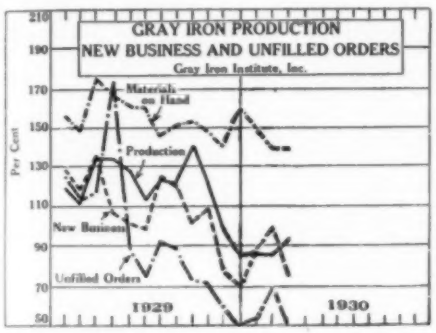
Climax Molybdenum Co., New York, has moved its offices from 61 Broadway to 205 Madison avenue.

Trade Trends in Tabloid

SALES of pattern lumber always an indicator of future castings business, are improving, according to those firms which specialize in this commodity. Farm equipment for tractor interests and steel founders are furnishing considerable business to pattern shops.

—T—T—

With the appearance of specifications for 2200 freight cars for the Illinois Central the active inquiry list for freight cars is in excess of 3000, the largest total in the past three or four weeks. Domestic freight car awards during April totaled 2952 com-



pared with 6001 for March.

—T—T—

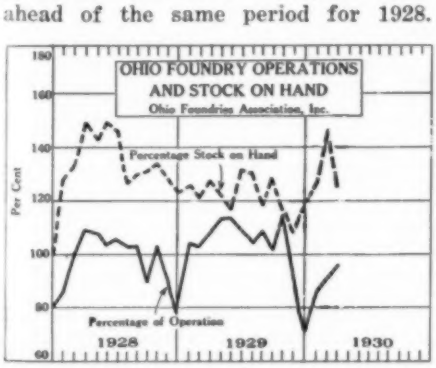
Prices on steel scrap are declining. Five successive changes in heavy melting steel at Pittsburgh during the month of April showed a steady decline.

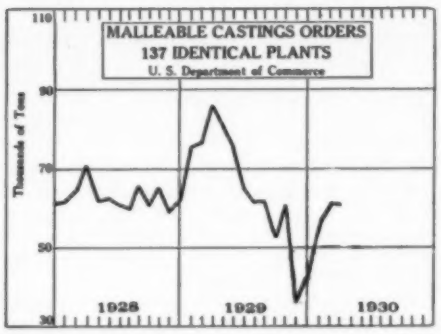
—T—T—

New orders for machine tools in March showed a slight increase for the first time since last October, according to the National Machine Tool Builders. The index for March is 177.8 compared to 172.6 for February.

—T—T—

The first quarter output for passenger automobiles and trucks was 998,556 compared with 1,452,910 for last year, showing a recession of 40 per cent. However, the first quarter production in 1930 is 30,000 units ahead of the same period for 1928.





Early estimate of April production gives 425,000 cars.

—T—T—

St. Louis jobbing foundries and specialty castings manufacturers report good business in prospect, although price reduction in iron have held up orders for that commodity. Stove manufacturers have increased operations slightly.

—T—T—

Northern pipe foundries are operating five to six days a week. The general volume of cast iron pipe business is higher than in 1929, but soil pipe remains inactive.

—T—T—

During March, according to the Gray Iron institute, 142 foundries throughout the country reported an average operation of 92.8 per cent compared to 85.5 per cent for February. March 1929 recorded 135.4 as the operating rate. New business received during March was 78 per cent.

—T—T—

RAW MATERIAL PRICES
May 6, 1930

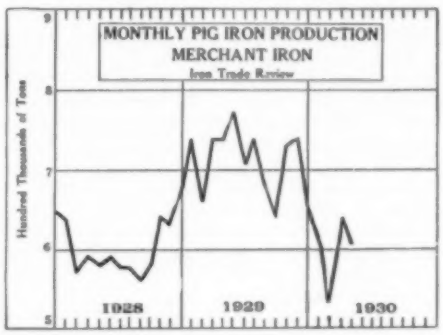
Iron	
No. 2 foundry, Valley	$17.75
No. 2 Southern, Birmingham	14.00
No. 2 foundry, Chicago	19.00
No. 2 foundry, Philadelphia	20.26
No. 2 foundry, Buffalo	18.50
Basic, valley	18.50
Basic, Buffalo	18.00
Malleable, Chicago	19.00
Malleable, Buffalo	19.00
Coke	
Connellsville beehive coke	$3.50 to 4.85
Wise county beehive coke	4.25 to 5.00
Detroit by-product coke	8.50
Scrap	
Heavy melting steel, Valley	$16.00 to 16.50
Heavy melting steel, Pitts	15.50 to 16.00
Heavy melting steel, Chicago	13.00 to 13.50
Stove plate, Buffalo	11.75 to 12.00
Stove plate, Chicago	10.00 to 10.50
No. 1 cast, New York	10.85
No. 1 cast, Chicago	13.50 to 14.00
No. 1 cast, Philadelphia	15.50
No. 1 cast, Pittsburgh	14.50 to 15.00
No. 1 cast, Birmingham	13.00 to 14.00
Car wheels, iron, Pittsburgh	14.50 to 15.00
Car wheels, iron, Chicago	14.25 to 14.75
Railroad malleable, Chicago	16.25 to 16.75
Agricultural mal., Chicago	14.75 to 15.25
Malleable, Buffalo	16.00 to 16.50
Nonferrous Metals	**Cents per pound**
Casting, copper, refinery	12.00
Electro, copper, producers	12.50 to 12.62½
Straits, tin	32.12½
Lead, New York	5.50
Antimony, New York	7.50
Nickel, electro	35.00
Aluminum, No. 12, producers	23.00
Aluminum, No. 12, remelt	16.00 to 16.50
Zinc, East St. Louis, Ill.	4.65

—T—T—

The unsettled copper market and receding prices have affected ingot buying. Foundries have considerable volume of castings on hand that have been produced in higher priced metal. Brass foundry activity in the Chicago district is normal with purchases from the oil, industrial, railway and car building lines.

—T—T—

Foundries and and machine shops in the southern states are active. Stove



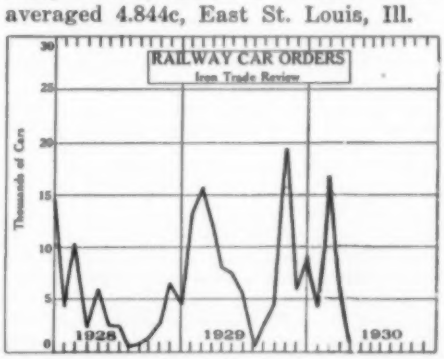
foundry operations are comparable with those a year ago. Cast iron pressure pipe contracts show a decline.

—T—T—

Iron and steel operations have shown slight improvement during April although the rate is considerably below that obtaining last year. The principal sources of demand at this time are the farm implement manufacturers and oil field consumers.

—T—T—

Brass ingot average prices for April reflect a general cut following the reduction in copper prices, according to *Daily Metal Trade*. Average New York prices during April for nonferrous metals, according to that publication, were as follows: Casting copper 15.302c; electrolytic copper 15.846c; Straits tin 36.073c; lead 5.537c; antimony 7.750c; aluminum 23.90c. Zinc averaged 4.844c, East St. Louis, Ill.



What the Foundries Are Doing

Reflecting the Activities of the Gray Iron, Malleable, Steel and Brass Shops

Brenneis Mfg. Co., Oxnard, Calif., has installed new equipment in its core room.

The warehouse and contents of the Union Iron Foundry, Union, S. C., were destroyed by fire recently. J. M. Moss is owner.

Continental Casting Co., Middletown, Conn., has been incorporated with $100,000 capital to manufacture and sell machinery and tools.

Kirk-Morrow Iron Works Co., Iola, Kans., has purchased the plant of the United Iron Works at Iola.

Harrison Steel Castings Co., Attica, Ind., is installing a new electric furnace. (Noted April 15.)

Rich Mfg. Co., 3855 Santa Fe avenue, Los Angeles, has installed several new molding machines in its foundry.

Meyberg Co., manufacturers of lighting fixtures, formerly located at 631 South Grand boulevard, Los Angeles, has moved its plant to a new location at 2845 West Seventh street.

Lee Foundry & Machine Co., Plymouth, Mich., has opened a sales office in the Lexington building, 2970 West Grand boulevard, Detroit, in charge of John Cole as sales manager.

Morel Foundry Corp., Seattle, Wash., is building an addition to its plant which will house its designing department, pattern shop and will extend its molding room.

Texas Brass Mfg. Co., Houston, Tex., has been incorporated with $25,000 capital by D. D. Daugherty, 1416 Elysian avenue, to manufacture nonferrous castings.

Odin Stove Co., Erie, Pa., manufacturer of gas stoves and gray iron castings, suffered a $10,000 damage to its building and products by fire recently.

The foundry of Sherman Machine & Iron Works, 18 East Main street, Oklahoma City, Okla., recently was damaged by fire. The loss was estimated at between $10,000 and $20,000.

Jewell Steel & Malleable Co., 373 Hertel avenue, Buffalo, is understood to have plans for a one story addition. The company manufactures malleable iron castings.

Detroit Gray Iron Foundry Co., 6403 Wight avenue, Detroit, has completed plans through Mildner & Eisen, architects, 924 Hamm building, for a foundry addition.

Manufacturers' Foundry Co., East 9th street and Fairbanks avenue, Holland, Mich., advises that it does not contemplate expansion. The information was presented incorrectly in the May 1 issue of THE FOUNDRY.

Imperial Foundries Co., 218 North Kentucky street, Knoxville, Tenn., recently sustained a fire loss to its plant. The damage is estimated at between $15,000 and $18,000. The plant may be rebuilt.

France Foundry & Machine Co., North Baltimore, O., recently was granted a building permit for an addition to its plant located at 1136 Girard street, Toledo, O. The new construction will cost approximately $2,000.

St. Catherines Brass Works, Ltd., St. Catherines, Ont., has been incorporated with $50,000 capital by John F. Pepler and Florence M. Sexton, to deal in aluminum, bronze, copper and monel metal castings.

Union Metal Mfg. Co., Canton, O., manufacturer of street lighting standards, has inaugurated an expansion program entailing the expenditure of approximately $20,000 on a mill-type plant addition.

Otto Stake, 1213 West Fifty-ninth street, Chicago, pattern maker, has been awarded a building permit for a 35 x 80 foot shop to cost about $6500. The architect is E. P. Rupert, 822 West Seventieth street.

Potter Foundry Co., Albert Lea, Minn., has leased all the foundry property of the Queen Stove Works, Inc., Albert Lea, and production of gray iron castings will be stepped up to capacity as rapidly as new machinery is installed. (Noted May 1.)

C. M. Grey Mfg. Co., 358 Central avenue, East Orange, N. J., maker of castings and antifriction bearings, proposes a plant building on that street but plans through the Austin Co., 120 Broadway, New York, are said to be incomplete.

Chemical Equipment Co., Chicago, which recently purchased the plant of the Montpelier Foundry & Machine Co., Montpelier, Ind., is remodeling the plant and a machine shop, 100 x 150 feet, is being constructed. A pattern shop unit also is nearing completion. (Noted May 1.)

Henry Hapt, associated with the iron and steel industry for several years, is establishing an iron foundry at Huntsville, Ala., for the production principally of cotton mill castings. Brake bands, grate baskets and other gray iron castings also will be produced.

Duriron Co. Inc., Dayton, O., manufacturer of castings, recently rewarded the contract for a foundry building. The plant is to be 80 x 80 feet and will cost $40,000. A 10-ton crane-way with a 40-foot span will be constructed through the center of the building. Geyer & Neuffer are the architects. (Noted Jan. 15.)

Ohio Steel Foundry Co., operating plants at Lima and Springfield, O., has purchased the steel foundry department and the steel casting business of the Industrial Brown-Hoist Corp., Cleveland and Bay City, Mich. The steel foundry is located at Bay City and will be continued in operation there. A 15-ton open-hearth furnace will be installed and other extensions made. John E. Galvin is president.

Kinney Iron Works, Twenty-eighth street and Santa Fe avenue, Los Angeles, has broken ground on its new foundry site on East Forty-ninth street between Santa Fe avenue and Pacific boulevard. Contract for the first group of buildings has been let to the Consolidated Steel Corp. When the new units are completed the machinery will be moved from the old plant to the new location. Some new equipment will be added at that time. It is planned to increase the capacity of the new building at an early date. The old plant of the company has been sold.

New Trade Publications

TEAPOT LADLES—Whiting Corp., Harvey, Ill., has issued a leaflet describing its split-spout ladles designed for easy cleaning and maintaining of the spout lining.

TRAMRAILS—Cleveland Electric Tramrail division of the Cleveland Crane & Engineering Co., Wickliffe, O., has issued a folder on its various monorail systems and methods of suspension.

REFRACTORIES—Quigley Furnace Specialties Co., Inc., 56 West Forty-fifth street, New York, has issued a folder on its lines of lining material. It explains the uses of the material in iron, steel and brass foundries.

OVENS—Despatch Oven Co., Minneapolis, Minn., has issued a catalog of the various types of oven equipment. Both interior and exterior views show continuous and intermittent type ovens. The ovens are described in detail. Construction, method of operation and control are given.

PYROMETERS—Leeds & Northrup Co., Philadelphia, has issued a catalog on its instruments for the control of power house equipment. The booklet contains illustrations of the various types of equipment and line drawings showing methods of operation. Views of typical installations also are given.

INDUCTION MOTORS—General Electric Co., Schenectady, N. Y., recently published a folder on two and three phase, ¼ to 50 horsepower at standard speeds, voltages and frequencies, constant or adjustable varying speed, continuous duty, 40 degrees Cent. rise, quiet-operating induction motors. Methods of control of those type motors also is discussed.

NICKEL CAST IRON—The International Nickel Co., Inc., 67 Wall street, New York has issued a booklet which, in six sections, discusses the uses of nickel in cast iron in the automotive, aeronautical, general machinery, machine tool and power fields. The final division is devoted to instructions on the use of that alloy and gives some analyses for various castings.

INDUSTRIAL TRUCKS—Atlas Car & Mfg. Co., Cleveland, has issued a booklet on the industrial trucks and tractors that it manufactures. The advantages and details of construction are explained and illustrated and the various types together with specifications are shown. Drawings show the dimensions of the units. Several illustrations show the different services in which the trucks may be used.

BUCKETS AND CLAM SHELLS—The Hayward Co., 50 Church street, New York, has published two folders describing and illustrating the advantages, construction and operation of the electric motor buckets and digging clam shells that the company manufactures. Illustrations showing typical installations and specification for each kind of apparatus are included.

SAWS—John Royle & Sons, Paterson, N. J., has issued a descriptive booklet on the electrically driven saws that it manufactures for patternmakers; cabinet makers, etc. The construction and design are explained in detail and the specifications given. Features of the machines when devoted to special uses are explained such as beveling gages, mitering gages, linotype slug cutters and micrometer attachments. The cabinet and column saws, circular saws and conditioning equipment are discussed on the last pages of the bulletin. The company also has issued a 16-page booklet on the cabinet saw and jig saw and drill that it manufactures.